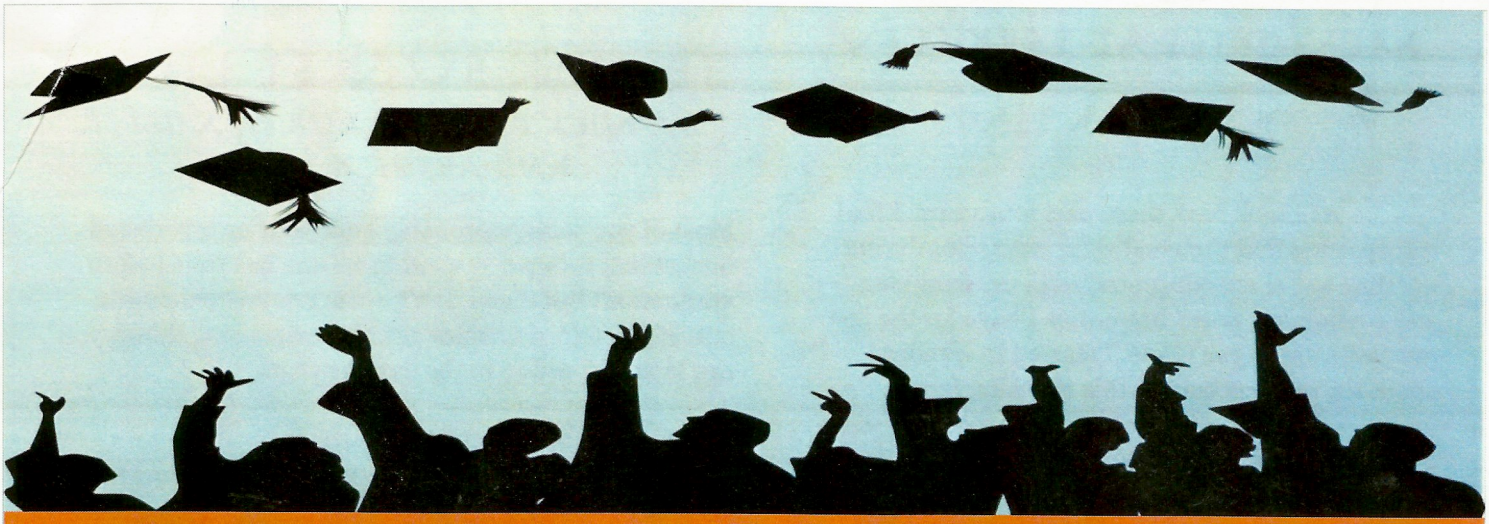


April 5, 2013

# SENIOR BANQUET

College of Chemistry
UC BERKELEY

*University of California, Berkeley*

AIChE®

# Memories at Berkeley

## By: Angela Tsao

As I look back these past four years, I find it surprising that the most vivid memories during my time at Cal are concentrated in my freshmen and sophomore years. Memories I have for the last two years are vague to me. I started to wonder about the reasons behind this shocking fact.

The times I remembered were the times when I was most socially active outside of my chemical engineering life. The times where I was most consumed by chemical engineering were the times that seemed to pass by the fastest. I think the reason behind this is that the last two years were the busiest years in my life. I did not have time to really "savor" every moment. Unlike in freshmen year, I was very much engaged with meeting new people, and exploring Berkeley.

I now believe that I really should have also balanced my life with work. However, I do not entirely regret my busy life; it clearly prepared me for my career. Yet what comes to mind is a quote from an article Kevin Ng, one of the past AIChE presidents, wrote in *Viscous Bulk*. He says, "When you look back at your undergraduate experience, you're not going to remember how many points you got on the second midterm of some class (though you should still do schoolwork), but rather the memories from the little things that you did on the side." It is really true! Why didn't I realize that for my past two years?

I, thus, encourage all the seniors to enjoy the last bit of their senior year. Create the last memories with your friends, and of course your fellow Chem. E classmates, who together fought with you these past four years against many all-nighters/staying late finishing problem sets, lab reports, and projects. For those who are not graduating yet, go to as many Cal football games as possible to find yourself taken by the Cal spirit. Take time out of your busy Chem. E life, and find a hobby. Balance the school work with your social life to recharge your batteries. You will find yourself to be more productive and passionate.

Go bears!

# Senior Bucket List ✓

## By: Nick Brady, Lauren Miller and Akshita Dutta

Most of you seniors probably have your own personal bucket list; things you want to do one last time before graduation! But if you don't, we are going to help you out! If you're not a senior yet, these are some things you can look forward to in the coming years

- ☑ Hike up to the Big C
- ☐ Visit the Campanile
- ☐ Take a nap on memorial glade
- ☐ Find the underground path that takes you through all the college of chemistry buildings
- ☐ Walk the Fire trail
- ☐ Watch the sunset from Indian rock
- ☐ Visit the Botanical gardens and/or Rose gardens
- ☐ Bike across the Golden Gate bridge
- ☐ Go to Triple Rock on a Thursday night
- ☐ Roll down 4.0 hill
- ☐ Cheer on your team during a sports event
- ☐ Visit the Marina
- ☐ Visit the Thai Temple to get awesome (and cheap) food!
- ☐ Go (or listen in)to a concert at the Greek Theater
- ☐ Get a drink with a ChemE professor

So get together with your friends and start working your way through that list but most importantly, enjoy your last few weeks at Berkeley!

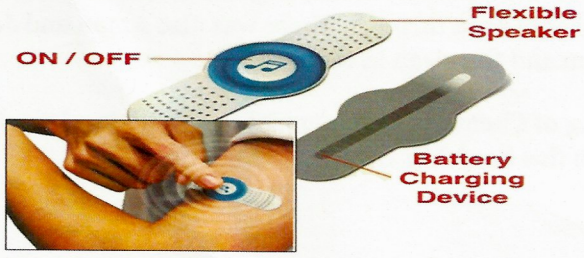
***Congratulations*** Class of 2013! GO BEARS!

# BODY HEAT AS AN ENERGY SOURCE

BY: JAMES MCDONALD

Many sources of renewable energy are being explored for use in the modern world. By now, the idea of generating energy through solar and wind power is familiar. However, other novel energy sources exist, such as waste body heat – a resting male generates approximately 100 watts. While our bodies don't produce energy on the same scale as solar or wind power, there are some interesting applications.

1. **Heating buildings**
   Kungsbrohuset is the name of a thirteen-floor office building in Stockholm, Sweden that is partially heated by waste heat from the nearby Stockholm Central Station. Approximately 200,000 people pass through the station each day, and their body heat warms the inside of the station. This warm air is passed through heat exchangers in the ventilation system to heat water. The heated water is pumped into Kungsbrohuset to fulfill an estimated 5-10% of the heating requirement. Want to know more? Read on at:
   http://www.bbc.co.uk/news/business-12137680
2. **Power jackets**
   At the nearby Lawrence Berkeley National Laboratory, researchers have developed silicon nanowires with thermoelectric properties, meaning that they can convert heat into electricity. These nanowires can be put inside a jacket, resulting in the ability to charge mobile electronic devices solely from body heat. Want to know more? Read on at:
   http://www.sciencedaily.com/releases/2008/01/080110161823.htm
3. **Personal electronic devices**
   Currently, the Seiko Thermic Watch is powered by body heat. In the future, this concept could be applied to other devices – the Skinny Player (pictured below), is a conceptual mp3 player the size of a band-aid that sticks to your skin and plays music through flexible speakers. In addition, powering devices solely by body heat could be useful in the medical field, such as in hearing aids or pacemakers. Want to know more? Read on at:
   http://hearinghealthmatters.org/waynesworld/2013/hearing-aid-power-supply-body-heat-ii/




# OIL MONOPOLY'S IMPACT: THE TRANSPORT SECTOR

BY: AMAN AGRAWALA

Due to the development of electric cars, a debate has once again been reborn concerning the future of clean technology, specifically the electric car and its potential to replace traditional vehicles. Although many of the issues that are the focus of this debate are genuine – they fail to reach a central issue – the oil monopoly's impact on global policy.

Central to clean technology's future is the monopoly of oil within the transport sector. Time and time again we have seen world economic security thrown off by the gyrations of the price of oil and the political instability within the Arab world. It is not coincidental that the recession and financial calamity of 2008 was preceded by a sharp rise in the price of oil. Furthermore, we witnessed that the same rise in oil soften our recovery in 2011. Very few commodities have such strategic value as oil and the fact that they are concentrated in the hands of those who tend to be in great instability bodes much ill for the global economic future.

The fact of the matter is that issues like these represent inordinate risks to the global policy environment – risks that are proliferated by our acceptance of the monopoly enjoyed by oil in the transportation sector. Although the pressure on these issues may die down for a while, they are immediately revived during the next oil shock or another calamity within the Middle East. Consequently, we are continuously reminded that we must encourage a free market to develop alternatives to oil and reduce the influence oil has upon the global economy.

The problem with oil is not just that it is a limited natural resource with an extremely high volatile price – many other commodities face similar issues. Oil is in a significantly different position because it in a monopoly position as the only strategic commodity within the transportation sector. Within a traditional free market, the price of commodities results in proper resource allocation and usage, generating demand for alternatives if necessary and stimulating investment and innovation. Although this is not perfect, it is far better than a monopoly. Furthermore, it pushes the private sector to provide solutions. Due to the massive barriers in entry for refueling of the transport sector, the market is unable to adjust to supply constraints and provide a range of solutions to distribute demand across a variety of resources. Although governments should not pick winners within the market, it is their job to act against monopolistic barriers to enter a market. This is precisely what needs to be done to oil's monopoly within the transport sector.

# WALKING DEAD

BY: CALEB ALEXANDER

It's been about 3.47 months since that day. The day the North Koreans nuked San Francisco and the infection spread. Berkeley was outside the initial blast radius, but the nuclear fallout managed to reach us. The civilians more susceptible to radiation poisoning died first. And that's when it began.

The end of the world all started from floor C. I was naïve back in those days. Before the outbreak. I used to day dream about what was inside of Hildebrand's mysterious floor C. The floor with only one way in and one way out. Heavily locked. I would imagine that was the place where dinosaurs were kept, and where all of the government's aliens from outer space were hidden away from Roswell, New Mexico. It was worse than my childish day dreams could ever comprehend. Turns out the biochemists in Stanley created a nasty bug back in the sixties as a part of the effort during the Cold War. Fortunately, we never came to the point where we needed it, so it was locked away in floor C. Until, the shockwave from the nuke caused a crack in the foundation and let the virus out. From those who died of radiation poisoning, arose the walkers. Clearly not living, yet still slowly walking towards you with a deep moan, and blank and empty eyes, the walkers wouldn't stop coming.

I've seen a guy drop from a bite wound and awake a few hours later as one of those things. We've also had several run-ins with other survivors. I'm not proud of the things I've done to survive.

We've bunkered down in the Chem Plaza as seen in Figure 1. Our group is restless. More than half of the group is ready to leave. Lauren plans on making a run for Texas, while Nick and Ak aren't quite sure where they're going yet, but all I know is that they're itching to escape this place. I'm not sure about Himani or Hilary's plans either. I think our current president Angela might stick around for a little longer, but we'll see how long. I think this place is worth saving and so do a few of the younger members of our group. Brad is constantly coming up with creative ways to improve our situation and Yoobin breaks the tension every once in a while from not knowing if today is our last day alive or if it's the day we get overrun. We've been showing the proverbial ropes to James and Sonal over the past year, and I think they'll make fine zombie slayers someday.

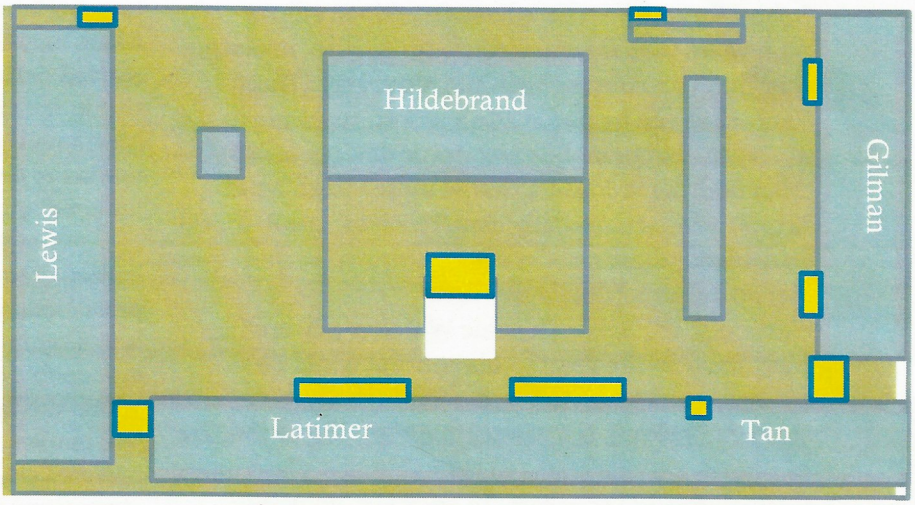


Figure 1: Layout of Chemistry Plaza. Blue blocks represent buildings and structures while yellow blocks represent barricades.

About a month ago, a small group with no more than half a dozen souls amongst the bunch ran across our complex. Some faces were familiar others friendly. There was Vik, tall as can be. You could tell this guy had been through a lot and that he had had his fair share of battle scars over his time here. Brad and Yoobin seemed to know the rest. There was Geoff who seemed pretty capable judging by the machetes in his hands, blood on his shirt, and none of it his. I had seen Ernest sneaking out and about every once in a while without any of the walkers ever noticing him. He was clearly a skilled scout. He was standing next to Nida, who carrying only a knife and a pistol, stood straight and looked at me with kind eyes, which is quite impressive considering all that she's probably been through. There was also Aman and Jay. They looked friendly enough despite the AK-47s in their possession and the glean in their eye.

After taking a vote, we decided to let this rag tag gang of Chemical Engineers join us. With hard work, determination and any luck, I hope to see us make it through this hardship alive.

## THE LOGISTICS OF NETWORKING

BY: HIMANI NADGAUDA

We've all heard the phrase, "It's not what you know, it's who you know." At this time in our lives where we are searching internships, jobs, and the best graduate schools, this adage is increasingly important. Networking, besides our prestigious UC Berkeley education, is arguably the best tool we have to achieve our professional goals.

We have plenty of opportunities to network in our daily lives as Cal students. Our professors have a wealth of knowledge about the latest research in the chemical engineering field and the arduous journey to success in academia. All we need to do to connect with them is attend their office hours or schedule an appointment with them in class or through email. UC Berkeley faculty members have some of the sharpest minds in the world. Since the College of Chemistry is such a tight-knit community, there is a favorable faculty/student ratio and faculty members have the time to be invested in their students' wellbeing.

There are plenty of folks from industry that pass through our campus daily. Oftentimes they are leaders in their respective fields. They can pass on essential advice on strategies current students or new college graduates should implement to succeed in the work force. It can be difficult to connect with professionals at information sessions or career fairs due to so many other students vying for their attention. This is why I prefer events with a more intimate atmosphere that offer students the opportunity to form solid connections with others. Biomedical Engineering Society (BMES) holds dinner events with start-up companies and Genentech. In a sit-down dinner atmosphere, it is easier to forge a genuine relationship with someone you've never met based on similar interests. The American Institute of Chemical Engineers (AIChE) has started holding Student Leadership Seminars where seasoned Cal alumni are returning to campus to share their knowledge with us. There is always a networking portion after the talk portion of the seminar and the alumni are happy to share their stories. Having an open mind and refusing to be shy is key to networking with professionals from industry.

Last but not least, us students can network amongst each other as well! After all, we have survived the tough chemical engineering curriculum at UC Berkeley together. We have learned from each other throughout this entire process. We've exchanged advice on everything from how to best go about solving a mass balance to how to effectively manage group projects. While we are working our way up to be the future leaders of tomorrow, we will assist each other just as we have done with problem sets.

## ENGINEERING 4 KIDS

BY: NIDA RUKHSHI

I walked through the hallways of Cory Hall, looking for a sign on the door that read: 'AIChE – Ice Cream Activity'. I didn't have to look for too long, though, as it was one of the doors with one of the largest groups of children (quite possibly THE largest) clamoring around outside, waiting for their turn to go in. Politely pushing past the crowd, I made my way through the door, only to be met with an even larger group of people inside. Young children filled the room, occupying all of the seats, with a few parents standing close by, lining the walls. AIChE officers bustled about, getting the final touches of the activity ready for the current group.

This was E4K, Engineering for Kids day, where Berkeley hosted a number of students in grades 4 through 6 who participated in a variety of engineering activities throughout the day, organized and held by undergraduates, including all of the various student-led Engineering groups on campus, graduates and faculty. AIChE's event was a classic: helping kids make ice-cream by putting the ingredients in a plastic bag, which was placed in another larger plastic bag filled with ice and rock salt and then shook. This was then followed up by a demonstration of ice cream being made using liquid nitrogen. Which was all then eaten.

Having figured out the process by which we were doing the activity, I took my place at the end of the line of officers standing behind the table of ingredients, and assumed the role of doling out the half-and-half. I was met with replies of 'hi's and 'thank you's, some shy, others boisterous, as I poured one cup of half-and-half into each plastic bag that was raised at me. Once all the kids had all the ingredients in their bags, the shaking commenced. Excited voices and laughter filled the air as the young students saw their ice cream begin to form. The rush to get toppings followed soon after, and then the enjoyment of eating their handmade creations ensued.

The feelings of contentment and accomplishment were high in the room, and soon, the activity began to wrap up. Kids began to leave, shouting out 'bye's and 'thank you's, a lot more comfortably than before, and chatting excitedly amongst themselves about the activity they had all just completed. The next group stood eagerly at the door, waiting for the room to empty so they could refill it, and the process could begin all over again.

Groups came and left, each one as excited and eager as the ones they followed, and much more ice cream was made and fun was had. All of the children were so eager to learn and to participate that volunteering at E4K never seemed like work. I had as much fun as all the kids attending that day and enjoyed every second of it. Even when the last group had left and all of us officers turned around to face the room and probably the biggest challenge of the day: the clean-up.

## BIG IDEAS IN CHEMICAL ENGINEERING BY: HILARY ZHENG

College of Chemistry at Berkeley is always an interestingness hunter-gathering place and curious mind at large. Some people might view college education as a tool to enhance their skills, but at Berkeley, what comes beforehand is interestingness. It is helpful to always keep in mind why chemical engineering matters in the world and how, because curiosity could bring us things we did not know we were interested in—until we are.

Our professors say chemical engineering is a cross-disciplinary subject—I found it easy to say but hard to do. I am still daydreaming to gain the ability to tap into the mental pool of resources— kinetics, thermodynamics, separations, transport, fluid mechanics, process development, and unit operations to current problem with commercial relevance—which we've accumulated over the years in college just by being present and alive and awake in the classrooms and libraries, and to combine them in extraordinary ways.

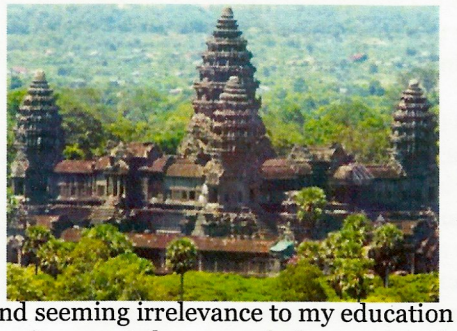
One of these extraordinary ideas could be batteries and fuel cells. Energy technology plays a critical role on an individual and societal scale. Electrochemical energy conversion systems, such as batteries and fuel cells, find applications in personal power such as handhold electronic devices, vehicles, and large-scale power plates. By designing and sizing the efficient electrochemical systems, we address the ways that thermodynamics, electrochemical reaction kinetics, and transport factor into power, integrating things we learned in the first two years in chemical engineering to analyze a single or hybrid combination of power sources.

There are more interesting examples. Biosensors, for instance, could provide us approaches to detection and quantification of biological molecules for diverse purpose ranging from medical diagnostics to environmental monitoring to food safety to defense. Catalysis is the fundamental enabling technology of chemical transformation. Most industrial reactions, including the production of fuels, polymers, chemicals, food, and pharmaceuticals, use a catalyst.

One stereotype of chemical engineering is that we are always making something big. In fact, chemical engineering can make something small, too. Chemical microsystems combine microfluidic channels, chemical-synthesis on a chip, and microscale separation to enable multiple synthesis and separation steps. We integrate microchemical systems to enable rapid, continuous discovery and development of new products with less environmental impact. In particular, the systems use fewer resources, generate less waste, require less space, use fewer utilities, and are safer than classical synthesis approaches. As microsystems for chemistry and biology technology matures, more applications are microsystems with emphasis on quantifying benefits of realizing small systems and scale-up by replication in comparison to convectional strategies.

Glancing at all those flash cards of big ideas in chemical engineering mentioned above, chemical engineering is indeed a cross-disciplinary LEGO treasure chest, full of pieces spanning design, science, technology, art and even more; pieces that enrich our mental pool of resources and empower combinatorial ideas that are stronger, smarter, richer, deeper and more impactful. Please enjoy.

## HOLIDAY IN CAMBODIA BY: W. GEOFFREY WINEGAR



I tried to absorb the slew of smells, sights, and sounds as my longtime friend, Ang, took us roaring through the streets of Phnom Penh on his rusty old moped. We passed the looming, pristine ministerial buildings—symbols of a genocidal government that continues to oppress, albeit less violently—and dove into the heart of the city. Street vendors hawked their colorful wares, a group of children played with a flaming can filled some kind of fuel, and construction workers and motorists thundered around us.

Much like this hectic scene around me, the two weeks I spent in Cambodia last winter break whizzed by in a blur. But in spite of the trip's brevity and seeming irrelevance to my education here at Cal, I was reminded of the daunting enormity of the essential work that awaits us out *there*—work that needs to be done by us chemical engineers. Here in America, it isn't too hard for us to point out our own energy inefficiencies and $CO_2$ emitters. In less modern countries like Cambodia, this task is trivially simple. Smog asphyxiates the central parts of the capital, jungles of tangled electric wires highlight grid inefficiencies, and open cooking fires spew plumes of smoke that pepper the countryside. Government-sponsored deforestation plagues the land and unclean drinking water poisons its people.


We do not earn our education here through long nights of studying and diligent hours spent in lab. Rather, we earn the knowledge we receive by implementing it to solve the critical problems facing human society today. Global warming is not just another American problem. It is our *world's* problem, and as such, the Earth's greatest minds will be required to solve it.

## "COOL" CHEMISTRY ON A HOT DAY
### BY: JAY YOSTANTO

After countless weeks of intense studying in my new college environment, I never realized how much I forgot about what it was like to be young. Well, I mean, not saying that being a first year in university is old feeling, but I forgot what it was it like to be middle school age. As I started my first shift working at E4K (Engineering for Kids) in the AIChE booth, I couldn't help feeling a little bit of nostalgia watching all the excited and rambunctious youngsters pile into the discussion classroom in Evans Hall. Their motivation for coming to our booth was no mystery; after all, we were the only booth making ice cream on this hot, bright day. Each time a new group came in, we would do our little prepared speeches on the properties of different states of matter and how liquid cream, sugar, and vanilla could be transformed into delicious, frozen ice cream with the use of salt, ice, and some fun shaking action. But that wasn't the best part. We even did a liquid nitrogen demonstration which of course harvested the many "oooh's" and "ahhh's" that come with seeing people in lab coats and goggles producing huge clouds of smoke in a classroom environment.

As the shifts moved on, I grew more and more comfortable working with the kids and teaching them about the wonders of chemistry and how it could be applied to something as "cool" as ice cream making through engineering principles. Whenever I had a question for them, I was blown away by the bright and curious minds that happily responded. I really realized after volunteering at this event that one of the most important reasons why we host events for these kids is because it truly is an inspiring experience for them to have and to get them more curious about the world around them and how it works. It's also inspiring for us volunteers. I have never had so much fun working with kids while working with the science I love to study every day. Spending time hitting the books is important, but getting out and applying/teaching what you study can be even more rewarding.

Working shifts with fellow chemical engineering majors was another major benefit of this experience. From just making small talks about Berkeley in general to talking about precious classes and internships, conversing with these like-minded people was a blessing and an inspiration. There's nothing more comforting then hearing words of wisdom from someone who has walked the path that you are about to walk while sharing all of the ups and downs that come with being a chemical engineer. I've always heard that networking is important but now I see that it goes beyond just trying to make connections for work; it's also to continually inspire you to learn more and love what you do. All in all, working at E4K and making ice cream with AIChE was a pretty "cool" experience!

## FIFTEEN YEARS BY: SONAL RANGNEKAR

"I want you to make long term goals. Where do you want to be in fifteen years?" That was our first assignment for the Life After Cal seminar, prompted by host Mike Cheng. In that first lecture, he spoke to us about his own career paths and career goals, and he stressed the importance of making those goals early on in life. I am no stranger to goal setting; it's that sort of planning that gets me through each day. But when Mike asked us to think fifteen years into the future, I drew a blank. Sitting in Bixby Commons, I couldn't begin to imagine where I would want to live or what type of car I would want to drive, let alone what I want from my career in fifteen years.
At first, I blamed my uncertainty on the fact that I'm only a first year who doesn't know enough about Chemical Engineering career paths to make meaningful goals. I realized only moments later that wasn't true. Being an officer in AIChE has exposed me to so many different fields and jobs I can have with a background in Chemical Engineering; a lack of information wasn't the reason for my ambiguous future.

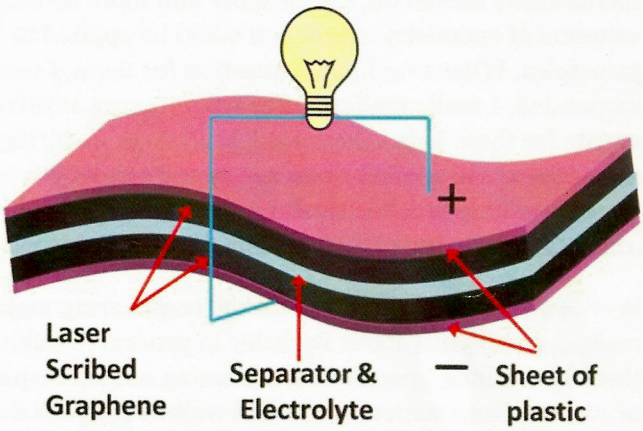
A little more introspection has made me come to realize that I simply don't want to make those goals just yet. I think it has to do with the fact that I've been looking to the future my entire life. In elementary school, I was always eager for the next school year, moving up to the next grade level and being that much smarter and mature. In high school, almost everything I did was to ensure that I would get into a good college. My first semester at Cal passed by a lot more quickly than I expected, and it makes me nervous that the next three years will be over faster than I'd like. So while I realize the importance of knowing what I want to do after I graduate and having an idea of where I want to be ten years after graduation, I don't want to fixate on those long-term goals. For a few more months I want to live for the moment, responsibly but wholeheartedly. I want to have dreams for today and make them realities tomorrow. And once I'm satisfied with the short-term, I'll give some real thought to the next fifteen years of my life.

# SUPERCAPACITORS -- THE END OF BATTERIES

## BY: VIKRAM SINGH

In 2010, The Nobel Prize in Physics was given to Andre Geim and Konstantin Novoselov at the University of Manchester "for groundbreaking experiments regarding the two-dimensional material graphene". The most notable of these groundbreaking experiments was the infamous tape experiment. They used adhesive tape to repeatedly split graphite crystals into increasingly thinner pieces, creating the 1 atom thick layer of graphite, known as graphene. Since then, many scientists have tried to find more practical methods to creating the Nobel Prize winning material. One such team of scientists, led by chemist Richard Kaner from UCLA finished devising an efficient method for producing high-quality sheets of graphene using nothing more that a consumer-grade DVD drive. While that in and of itself was considered groundbreaking, the real surprise came last year, when Maher El-Kady, a researcher in Kaner's lab, decided to wire a small square of their high quality carbon sheets up to a light bulb. It was then that something incredible happened - they created graphene supercapacitors.

So what exactly is a "supercapacitor"? Well let's start with a battery. A battery can hold a lot of energy, but it takes a long time to charge. A capacitor, on the other hand, can be charged very quickly, but holds a comparably tiny amount of energy. A graphene supercapacitor is the best of both worlds, taking seconds to charge, yet storing large amounts of energy. Imagine being able to charge your spent laptop or phone battery in 30 seconds, and your electric car in a few minutes. Moreover these graphene superconductors are nothing more than carbon, meaning that they are non-toxic.




Kaner and El-Kady have very recently demonstrated a scalable fabrication process that could make their supercapacitors cheap to produce while expanding the possibilities for their use. Their technique, according to UCLA is as follows: They glued a layer of plastic onto the surface of a DVD and then coated the plastic with a layer of graphite oxide. Then, they simply inserted the coated disc into a commercially available LightScribe optical drive — traditionally used to label DVDs — and took advantage of the drive's own laser to create the inter-digitated pattern. The laser scribing is so precise that none of the "interwoven fingers" touch each other, which would short-circuit the supercapacitor.

To take the supercapacitor to the next level, UCLA said, the researchers tinkered with the electrodes, placing them "side by side using an inter-digitated pattern, akin to interwoven fingers," UCLA said. "This helped to maximize the accessible surface area available for each of the two electrodes while also reducing the path over which ions in the electrolyte would need to diffuse. As a result, the new supercapacitors have more charge capacity and rate capability than their stacked counterparts."

The researchers add that "these micro-supercapacitors show excellent cycling stability, an important advantage over micro-batteries, which have shorter lifespans and which could pose a major problem when embedded in permanent structures – such as biomedical implants, active radio-frequency identification tags and embedded micro-sensors – for which no maintenance or replacement is possible."

As Kaner and El-Kady push to get this technology commercialized the possibilities are endless, and who knows, maybe batteries will soon be a thing of the past!

The UCLA research was recently published in the journal of Nature Communications.