1 JCCU Industrial Tour report – San Francisco 2011

This is the report for the 2011 Oxford Materials Departmental tour to San Francisco.

San Francisco is located just 45 minutes north of Silicon Valley, which made the location particularly appealing to a department that studies semiconductor materials so thoroughly. The area is known for its huge enthusiasm in embracing novel research and employs over 250,000 researchers, scientists and experts in the field of semiconductor technology.

1.1 Schedule

The tour dates were from the 13th to the 24th of March 2011. We flew from Heathrow to San Francisco to stay there for 10 days, returning overnight on the 23rd. For the industrial part of the tour, we spent four days visiting five companies, Applied Materials, NASA Ames, Morgan Ceramics, Dolby Digital and Stanford University.

A concise version of our itinerary follows:

Date	Plan
Sunday 13/03/11	Depart LHR at 11:00 Arrive SFO at 14:50 Check into HI City Centre Hostel.
Monday 14/03/11	Tour of San Francisco by Motorized Cable Car.
Tuesday 15/03/11	Applied Materials Industrial Visit
Wednesday 16/03/11	Free day in the city
Thursday 17/03/11	NASA Ames Visit
Friday 18/03/11	Stanford University Visit
Saturday 19/03/11	Day trip to UNESCO Heritage Listed Yosemite National Park
Sunday 20/03/11	Free day in the city
Monday 21/03/11	Dolby Industrial Visit and Morgan Ceramics Industrial Visit
Tuesday 22/03/11	Free day in the city.
Wednesday 23/03/11	Depart SFO at 20:50 Arrive LHR at 13:55 (on 24/03/11)

1.2 Companies visited

1.2.1 Applied Materials

Applied Materials is a leading US company involved in semiconductor manufacturing. Specifically, they create and commercialise nano-manufacturing techniques for the production of integrated circuitry for electronic gear, flat panel displays, glass coatings, flexible coatings and photovoltaic cells.

Upon arrival, we were given a thorough introduction to exactly what Applied Materials does, who they employ and how their employees work. After a delicious Greek themed lunch, we were introduced to

two very recent interns, who were especially relevant to us, since it allowed us to see the level of research and responsibility that students in a position similar to ours were given.

We gained many insights into the intricacies of semiconductor design, including the use of oxidising and nitriding as well as the incredible accuracy to which the silicon wafers must be polished and ground down to.

1.2.2 NASA Ames Research Centre

NASA Ames uses over $3billion in equipment, employs over 2,300 research staff and has a $600million annual budget dedicated to everything from advanced space flight to weapons manufacturing. Their research frequently relies on progression in materials technology, especially materials for photovoltaic cells and heat resistance.

Firstly, we visited Kleenspeed – a car battery development lab for electric cars. Seeing how materials can have an impact on battery efficiency was fascinating, as was test driving the car they were using to try the battery out!

We were treated to a display of the modelling capabilities of Pleiades supercomputer, which was the seventh fastest supercomputer at the time of visiting. It was planned for further upgrades in late 2012. This was fascinating, as the talk started with an insight into the modelling of the heat flow around a space shuttle returning to earth which was especially relevant to those of us that had, or planned to, study the materials modelling coursework and gave a great insight into the engineering applications of materials. We were then shown a simulation of two galaxies colliding to really show off the processing power of Pleiades.

We moved from supercomputing to a demonstration of some of the achievements of Ames, particularly in the development, design and testing of the lunar lander and space shuttle, as well as their part in training dozens of astronauts and pilots in their state of the art training simulators. It was really inspiring to be able to walk through the cockpit of the lunar lander and see first-hand what the cutting edge of engineering, materials and physics has allowed us to achieve. We were even allowed to try landing several planes in the two simulators they had set up.

1.2.3 Stanford University

Stanford University was (at the time of visiting) ranked 2nd in the world for Engineering and Technology, so we knew we were in good hands when we started our tour of their campus (which also happens to be the 2nd largest campus in the world). It is the pioneering spirit and enthusiasm that universities such as Stanford generate which has allowed the scientific community of Silicon Valley to thrive and grow. Students and companies in the area are always working together, studying and growing as one.

On our visit to Stanford, we got a chance to explore their materials labs, many of which had students busy researching or conducting experiments, so we also were able to get a view at what life and study were like for students there and see the kind of instruments and materials they use throughout their course. Specifically, the Gabelle Laboratory for Advanced Materials, which houses the largest characterisation lab on campus, bringing together students from many disciplines to make use of the many electron microscopes and XRD machines.

This well-equipped lab stems from Stanford's particular interest in nanomaterial's, especially magnetic and electronic nanomaterials, with the latter typically using gold nanodots. In light of this, we were shown some of their recent research into magnetic biosensors and biochips. As well as some images of magnetic nanodots.

We also viewed their new Bio-X labs, which had been specially designed to allow labs to be resized and walls moved on the fly, allowing an adaptable workspace for research. As the name would imply, it is heavily interdisciplinary, focusing on biomedical materials, sensors and impants. Hence our brief stay here, as the majority of the labs are focused around clean rooms, or are rented by private companies.

1.2.4 Dolby Digital

Dolby Digital manufacture audio compression technologies, as well as more recently, video, film and DVD. On our visit to Dolby, we were recounted with an interesting history of the company, including their newest development on 3D cinema, which actually used nanofilm layered materials in the glasses to absorb different colours of light by different amounts in order to create a genuine 3D image without the need for spectroscopic film. It was clear that Dolby provided a highly supportive and attractive environment for their staff.

This visit also included a structural tour of the Dolby building, which in common with many older buildings in San Francisco had been retro-fitted with steel girders to provide resistance to earthquake damage.

1.2.5 Morgan Ceramics

Morgan Ceramics at Haywood (and Metals, as it turned out) have two distinct labs. One of which is dedicated to ceramic research, mostly alumina based, and the other is dedicated to metals, mostly the production of precious metal products and the creation of novel alloys of these metals.

We started with a talk about what exactly the facility did and how they worked. It was most interesting to see just how much creative freedom some of the researchers had.

On the ceramic side of the facility, we got to see the entire process of creating a complex ceramic component, from creating the powder, to sintering and machining. These ceramics are used in everything from power line housing to fighter jet engines, being of incredibly high purity and quality.

On the metal side of the facility, we had a demonstration of spin casting, creating a huge amorphous metallic sheet by cooling it by up to 1,000,000^{o}C a second. We were also able to see the wide range of metals they are currently interested in using for novel alloys, especially gold and platinum for conduction and catalysis purposes.

1.3 Tours

1.3.1 Tour of San Francisco by Motorised Cable Car

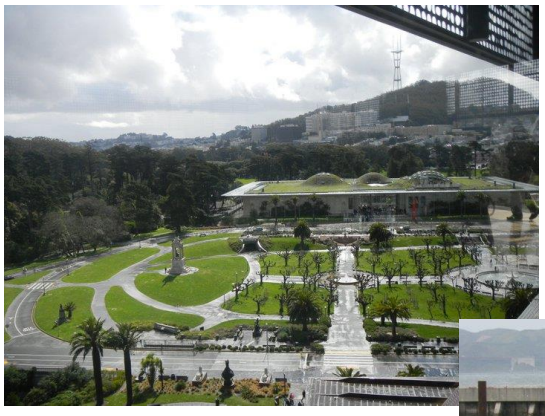
Combining the iconic cable cars of San Francisco with a tour of the city seemed like a perfect way to get everyone acclimatised to their new surroundings and seeing the Golden Gate Bridge had to have been a highlight, despite the fog.

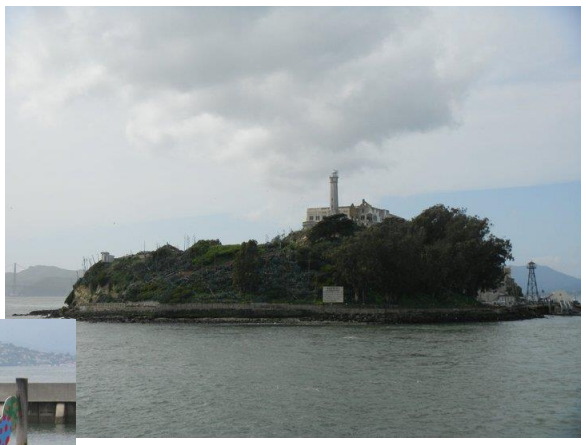
1.3.2 Tour of Yosemite National Park

Although it took us about 5 hours each way and meant a very early start, Yosemite was worth the wait. It's beautiful scenery combined with a brilliant tour guide meant that we really got the most of our journey. Yosemite in March is akin to a winter wonderland – snow is melting and hanging off trees, waterfalls are everywhere and the air smells beautifully clear. The view we got from the top was simply stunning. Even if we did end up a bit damp from the snow!

1.3.3 Free Time

In the couple of days we all had free, we got a chance to make the most out of San Francisco, with its lively hub of cultures and especially food. San Franciscans are very proud of their food and delight in helping point out tasty places to eat. Alcatraz, the Museum of Modern Art, Ghirardelli's chocolate factory and Golden Gate Park were all traversed by different groups of Oxford students, depending on who felt like seeing what.





1.4 Feedback of students

“I loved the huge melting pot of cultures San Francisco has, walking from one neighbourhood to the next; you never know what you’ll find!”

“Seeing what NASA work on at Ames really helped me see just how broad a subject materials can be. As an added bonus, I also got to (try to) land a plane.”

Generally, all the students had an amazing time; we got to explore a place so full of life and enthusiasm. You can really see how Silicon Valley exploded into life and how it holds some of the world’s cutting edge research facilities.

1.5 Thanks

Thanks to Morgan Ceramics, World Gold Council, The Worshipful Company of Armourers and Brasiers, The Worshipful Company of Ironmongers and Oxford Materials Department for sponsoring this trip and making it happen.

Thanks to Dr. Adrian Taylor and Mr. Barry Fellows, both of whom helped us organise all the finances for the trip and were happy to help point us in the right direction.

Finally, thanks to Morgan Ceramics, NASA Ames, Stanford University, Dolby Digital and Applied Materials, for being such gracious hosts.

Camden Ford & Naomi Omori