Romaine Baud, internship report from 17.10.2016 till 19.10.2016

3 days internship at the Institute of Material Sciences, University of Stuttgart

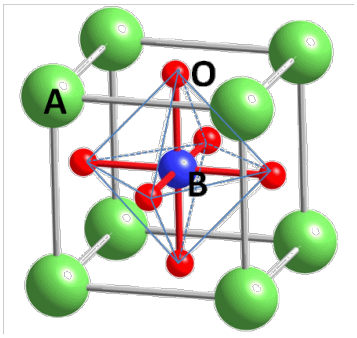
Foreword:

Finishing this year my apprenticeship as chemistry laborant at the University of Fribourg (CH), the question of further education comes up. My growing interest for natural sciences in general, and in particular for chemistry and biology, encourages me to consider higher level of education in a University, Polytechnic School as ETH or "Fachhochschule", as I am currently achieving my "technische Fachsabitur" along with the apprenticeship. The opportunity to join a 3 days internship at the University of Stuttgart with a focus on material sciences has been presented to me by Prof. Dr. Anke Weidenkaff, and this short document summarizes this visit.

New materials for energy technologies I:

On my first day, Prof. Dr. Anke Weidenkaff and Dr. Songhak Yoon kindly welcomed me. Then, I met Dr. Marc Widenmeyer, who presented me two of his group's projects concerning new energy technologies. The first one consisted of producing hydrogen by a photoelectrocatalytic reaction that only requires water, light, and a special compound, named perovskite (ABO_3). In my opinion, being able to produce hydrogen through such an ecological mean instead of the hydrocarbons cracking is nowadays very pertinent.

The second project was about a photo-reduction of CO_2 to restrict its emission. Perovskites and solar energy were also used for this reaction.



General structure of a perovskite
http://www.grl.shizuoka.ac.jp/~ddsfu/anim8.gif

New materials for energy technology II:

At the second visit, Tobias Kohler, a master student in material sciences, explained me how he synthetises one sort of perovskite (Eu, Ca)Ti(O,N)$_3$ in the lab. I was also able to understand that he strives to replace partially the oxygen of his perovskite oxide by nitrogen (ammonolysis) to form perovskites oxynitrid thus reducing the band gap of the reaction of water splitting.

Bio-inspired materials and systems I:

At the third stage of this internship, two students Dipl.-Ing. Andrea Knöller and M.Sc. Achim Diem, explained me the mimic of the structure of nacre from shell by using V_2O_5. Once the process completed, they reduce the imitated result into thin sheets allowing them to measure some properties of this stable material as the conductivity or pliability. I have found very interesting that they could synthesise some natural compounds and obtain some intriguing properties from them.

Bio-inspired materials and systems II:

Microscope image of a coccolith

At the second day of my internship, Dr in biology Giulia Santomauro explained to me two of her projects. She uses micro algae capable to produce coccoliths (plates of calcium carbonate), the target being for instance to use these algae combined with coccoliths to absorb some of the heavy metals, as zinc, polluting rivers. Her second project consists of using another type of algae eukaryote and mobile to produce micro-robots. These micro-robots could be capable to transport a certain type of medicament and to deliver it in the body to the right and sole place with the aid of magnets. I have found both projects very promising.

Thermoelectric materials and systems I, II, & III:

In the afternoon, I could attend a conference of Prof. Dr. Anke Weidenkaff about the synthesis and properties of inorganic materials. Thereafter, I met M.Sc. Xingxing Xiao who explained to me how she prepares her type of perovskite $(Ba,Eu)TiO_3$ to the thermoelectric analysis. M.Sc. Tianhua Zou gave me then a short introduction on the DSC (differential scanning calorimetry), an apparatus able to measure the thermal conductivity by determining how much of energy is required to increase the temperature of 1 °C of a sample. Being very stable, the sapphire is used as reference for this analysis. Finally I could talk to Dr. Wenjie Xie who showed me how he makes a Heusler alloy of type TiNiSn made of a cubical crystal structure. This material holds several qualities, as the magnetism or the thermoelectricity. Dr. Wenjie Xie explained to me then how we could qualify a thermoelectric substance as efficient by using the ZT formula.

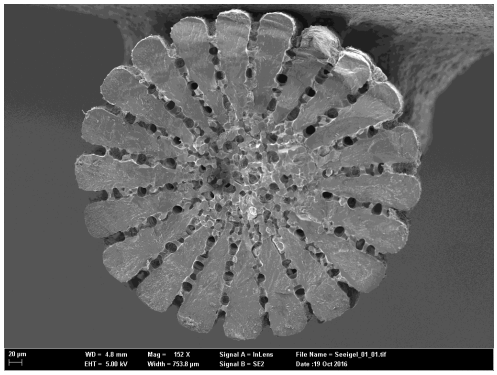
Bio-inspired materials and systems III:

On my last day at the institute of material sciences, I first met Dr. Petia Atanasova, who studied organic chemistry in Bulgaria. In her research, Dr. Petia Atanasova uses a virus of type Tobacco Mosaic and set some zinc oxide, or sulphide on this virus to create very thin (4nm diameter) and long nanotubes. The interest is that this virus is

made by an organic and inorganic part at the same time. The tobacco Mosaic virus is fortunately not dangerous for humans, rather only for the tobacco plant.

Bio-inspired materials and systems IV:

I then followed M. Sc. Stefan Kilper in a protected atmosphere room, which holds a SEM (scanning electron microscopy) that gives incredible pictures at a nanoscopic scale. We observed some bacteriophage viruses that only infect bacteria. I was also glad to see a very ordered structure of a spine of a sea urchin and some cartilage of octopus. The result with the SEM is awesome and I was very surprised to know that some projects of the institute have the aim to imitate such structures that are particularly stable.



Spine of sea urchin picture took on the SEM on the 19th of October 2016

XRD:

Finally, Dr. Songhak Yoon and M. Sc. Cora Bubeck explained me broadly the operation of an XRD (X-Ray Diffraction). They often use this machine to determine the crystal structure of their products as well as the nature and position of the atoms forming the crystalline pattern. This method offers a very precise analysis without damaging the samples

Conclusion:

I will keep an excellent memory of my three days of internship in Stuttgart. I discovered many things that have encouraged me to learn more about material sciences and it was a super experience for me. My choice is shaping gently, but I would be very happy to continue my education in material sciences, which has seemed fascinating to me. I would like to thank all doctors, students I met who welcomed me so kindly and who devote their time to me. I am especially grateful towards Juliane Kränzl, Dr. Songhak Yoon and Prof. Dr. Anke Weidenkaff without whom my internship wouldn't have been possible.