

Report for Graduate Student Exchange Program based on the Academic Exchange Agreement

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Name

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Research Period

From May 01, 2016 to September 23, 2016

Research Theme

Evaluation of Electromagnetic Properties of Polymers for Actuator Application

アクチュエータ応用のためのポリマーの電磁特性の評価

Research Results etc.

During this internship, we modelled the electrostriction of heterogeneous polymers using a finite element analysis and simulation software called COMSOL. Hence, to be sure of the accuracy and importance of our results, first of all, we studied the importance of controlling and checking the software. Every parameter has its importance, therefore we studied their importance, their impact and how to properly input them. We highlighted the importance of the mesh and its resolution, checking its convergence for every simulation. Also, you cannot fully trust the software and should look at every single parameter post-process looking for aberrant results and validating them physically. We also showed how to properly represent the reality by adding air surrounding our system and how to best configure the surroundings. At the same time we studied the effect that had surrounding air on our studies: so far it only adds edge effects, the pinching we can see on the borders of our samples during the experiences. As well we found the differences between the two modules (Electric Currents and ElectroStatics) that proposes COMSOL for electrostatics studies. As they both represent two sides of the same coin, we could discuss the best one for our study and finally routed for EC as it is closer to the experiment by taking into account electrical conductivity and the possibility for a current to pass within our material.

Now that we had a better understanding of COMSOL, we started studying a model that aims to represent the mechanisms of electrostriction in heterogeneous polymers. It is a good model based on the heterogeneity of the polymer, it is the only possible way of explaining it. But so far, we found out that this model was mainly false as it did not take into account all the material properties at stake in the electrostriction. We highlighted the importance of the electrical conductivity within the model but we did not get to the experimental results yet. However, we only started studying the conductivity and did not explore it as widely as the relative permittivity. Modifying the ranges of our conductivity variations, the geometry of our systems to match more the reality and else. There is still many research and simulations to do about that.

Comments to this program

It was a very interesting program. Professionally, it allowed me to explore a broadly used finite element analysis software and get a hold on it while improving my knowledge in electrostriction (coupling electrostatics and solid mechanics physics). Personally, it was a perfect opportunity to discover Japan, getting in touch with its culture, enjoying its modernity while contemplating its traditions. It was a cultural exchange I really appreciated.