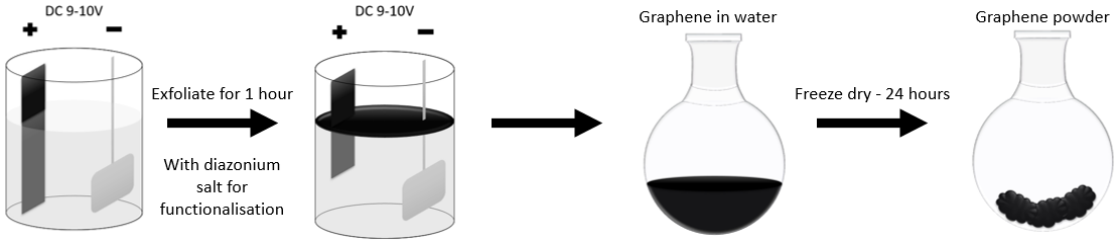
Biweekly report: Functionalised graphene for polymer composites

Emil Tveden Bjerglund

8 sep 2017

Several groups have shown great interest in our work with production of functionalised graphene for polymer composites.



In this project we will attempt to produce batches for testing in various companies with various goals:

- Radisurf (Intends to do ATRP-polymerisation on the graphene and embed it in silicone).
- SP Group (Interest in testing it for their PUR products).
- Newtec (Interest in graphene with different functionalities for better interaction with their quantum dots).
- Chemical Engineers, AU (Repetition of our work in Andreas' bachelorproject for potential publication).

These projects will hopefully give some more experience in handling large quantities of graphene and give some interesting applications.

Lab journal available at https://emiltb.github.io/graphene-production/lab_journal.html

Planned experiments from last biweekly report

- Continue working with large scale production and start a big production of Gr-NH_2 for Radisurf (in progress)
- Discuss possibilites of publishing Andreas' work with the chemical engineers (in progress)
- Redo high-voltage bipolar electrochemical functionalisation (not started)

Gr-NH_2 production for Radisurf

Radisurf wants to have a few grams of amine-functionalised graphene to do ATRP-polymerisation and later incorporation in silicone. I have started fabrication of this.

Experimental setup

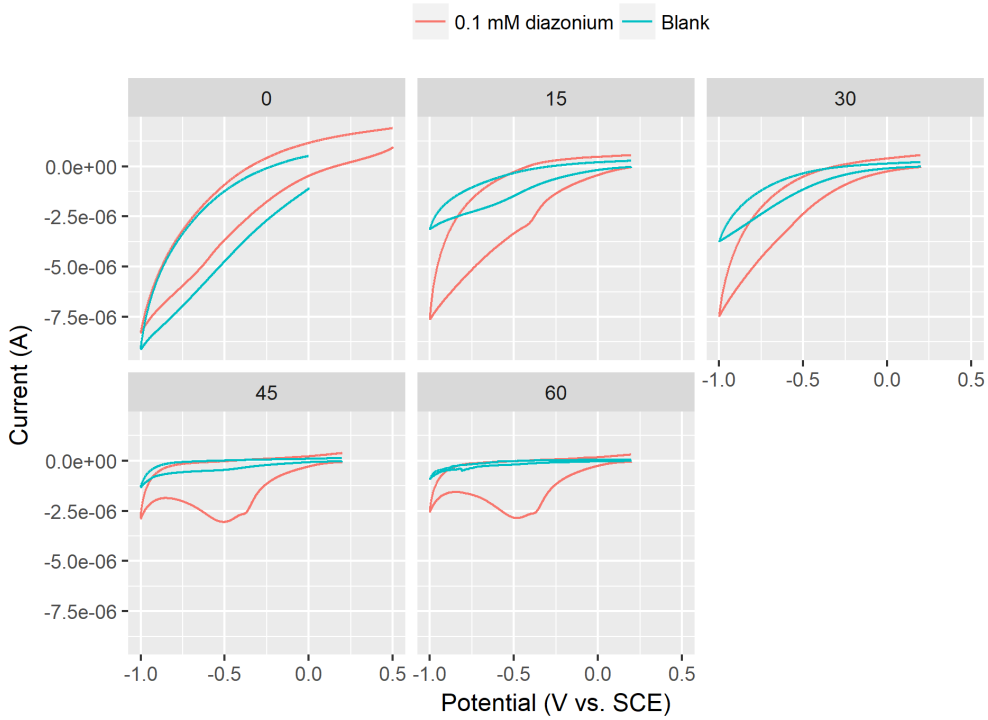
An 8x15 cm^2 graphite electrode was exfoliated in 0.1 sulphuric acid containing 2 mM 4-(2-aminoethyl)benzenediazonium compound (generated *in situ*). 10 V was applied between the graphite anode and stainless steel cathodes for 90 min.

0.5 mL samples were extracted every 15 min and diluted in 9.5 mL 0.1 M H_2SO_4. CVs were obtained from these solutions in an attempt to follow the diazonium concentration. The reason this is interesting to study, is that the solution heats up to ca. 70 degrees during exfoliation, which could potentially degrade the diazonium compound in solution.

Results

By weighing the graphite electrode before and after it was found that **5.2 g graphite was exfoliated in 90 min**. This is currently being further processed, so that Radisurf can get it as a dry powder in the end.

The CVs of the solution at different times is shown below.



It is not immediately clear that this is a good technique to follow the diazonium concentration. I made a quick test by dissolving a bit of ferrocene in DMF and adding some of the diazonium-solution. This gave a green color both before and after the exfoliation, indicating that the diazonium-compound survived the high temperature.

Conclusion

A large quantity of graphene was exfoliated in a quick and easy way. The processing of these large quantities is more difficult, but can be done. I expect to have graphene ready for Radisurf (and general characterisation early next week).

Plan for the next two weeks

- Make and discuss a more detailed plan for collaboration with the chemical engineers.
- Finalise production of graphene for Radisurf and characterise the product.
- Produce graphene for SP Group.