Graphene barriers from foamed biopolymer solutions

Diploma work description

Introduction

Paper and board are important packaging materials, but due to their high oxygen and water permeability, they are usually combined with one or more barriers. Barriers commonly used are plastics or metal foil. Graphene has unique barrier properties in combination with strength and low weight and would therefore be ideal as a barrier in many applications. It would provide an extremely thin and strong barrier to both gases (oxygen and water vapour) and liquids (water), which is only paralleled by aluminium foil.

Project description

One potential way to achieve a coating with good barrier properties is to make an even distribution of oriented graphene flakes. This can be obtained by coating the substrate with a foamed biopolymer solution containing dispersed graphene. The idea is that the graphene flakes will be entrapped in the foam lamellas and, after foam collapse, a thin layer containing oriented graphene flakes will be formed. The barrier properties will be further improved by crystallization of the polymer.

The objectives of this diploma work are to:

- Develop biopolymer foams with different foam properties (lamella thickness, bubble size, stability and collapse). The effect of i) type of biopolymer; ii) biopolymer concentration and iii) foaming procedure on the rheological and the foaming properties will be evaluated.
- Include graphene in the most promising biopolymer foams.
- Coat a substrate with the developed foams.
- Characterize the biopolymer solutions, the foams and the formed film with respect to e.g. rheological properties of biopolymer solution, foam stability, foam and film structure and distribution of graphene in the film.

The working procedure will be a largely iterative process, and the student is required to take own initiatives and work independently.

The diploma work will be performed at Soft Materials Science, SP Food and Bioscience, Göteborg. The work is a part of a large SIO Grafen project with several industrial participants and Chalmers.

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