An innovation on deterministic graphene origami

A.F. Juarez-Saborio[a,b,c], F. Bouquard[a], V. Barnier[c] , F. Vialla[b], A. Piednoir[b], R. Galafassi[b] , R. Fulcrand[b], C. Donnet [a] , F. Garrelie[a] et A. San-Miguel[b]

a. Université de Lyon, Université Jean Monnet-Saint-Etienne, CNRS, Institut d'Optique Graduate School, Laboratoire Hubert Curien UMR 5516, F-42023 Saint-Etienne, France
b. Université de Lyon, ILM, UMR5306 Université Lyon 1-CNRS, F-69622, Villeurbanne, FRANCE.
c. Université de Lyon, Mines Saint-Etienne, CNRS, Laboratoire Georges Friedel UMR 5307 CNRS, F-42023 Saint-Etienne, France

e-mail: ana-florencia.juarez-saborio@univ-lyon1.fr

Graphene planes exhibit physical and chemical properties that depend on its curvature [1,2]. The creation of deterministic or stochastic graphene folded fields or n-layer graphene stacks is an active research area with different approaches[3,4].

The goal of this project is to create an original method for the realization of surface fields with tunable multiscale texturing, relying on deterministic and reversible graphene folds. The idea comes from the Japanese art of origami, where we take a 2D surface that when folded transforms into a 3D structure. With the capability of repeating the process of folding and unfolding perfectly. The aim is to develop novel nano devices or surfaces with tunable physical properties. Our strategy will allow us to transform a graphene surface supported through the uniaxial or biaxial compression of an elastomer substrate. The latter will have been previously etched using ultra-fast laser or Focus Ion Beam texturing to create the micrometric structures that will serve as a "pattern" for the expected folds of the graphene that will be deposited.

We present here the first results on this innovative approach. We demonstrate the creation of wrinkles on the graphene surface with a deterministic, reversible, and even repeatable (several fold/unfold processes) behavior. Atomic Force Microscopy was used to characterize the height profile of graphene under varying levels of elastomer stress. By analyzing the height profile as a function of stress percentage, we were able to demonstrate control over the height of the graphene folds.
Raman Spectroscopy was also employed, to determine the induced defects (or lack there of) present.

Références

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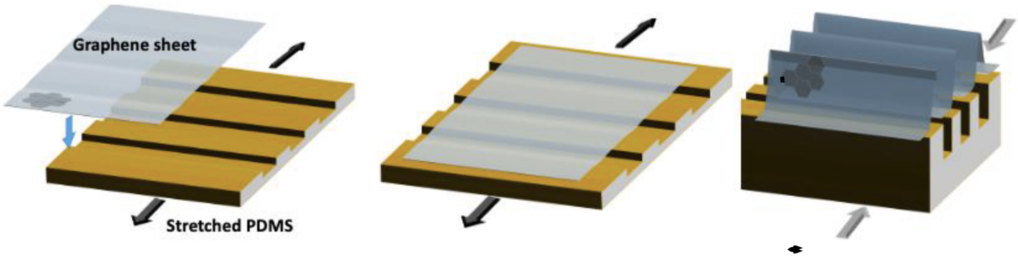

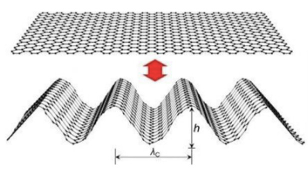

Figure 1 : Fig. demonstrating the process of setting graphene sheet onto textured polymer with a given stress, then releasing said stress to have the structure subdue periodic folds.