Contribution ID: **625** Type: **Invited Speaker / Conférencier invité**

Interfacing organic and carbon-based nanomaterials towards their applications in sustainable energy

Wednesday 17 June 2015 09:15 (30 minutes)

From the 1996 Nobel Prize for Chemistry, recognizing the synthesis of fullerene, to the 2010 Nobel Prize for Physics, awarded to the discovery of graphene, carbon-based nanomaterials have evolved into one of the hottest area in materials science. Utilization of large-area graphene thin films as transparent conductors in solar cells and energy-efficient light emitting devices may take significant advantage of a deeper understanding of their electronic and optical properties at the nanoscale. Applications exploiting the extremely high thermal conductivity of these materials are also emerging. A common denominator between many application-oriented graphene-based thin films is in the necessity of understanding their properties when they are interfaced with organic materials, including conducting polymers, organometallic nanoclusters and small polyaromatic molecules. In this presentation, I will review what our group has learned on the physical properties of graphene laminates, graphene-organic nanocomposites and graphene-based organic solar cells. Although all of these properties are reminiscent of the fundamental physics of individual graphene layers, a number of other concepts, related to their nanocomposite nature, are required to design large-area graphene thin films suitable for practical uses.

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Session Classification: W1-1 Carbon-based materials (DCMMP) / Matériaux à base de carbone (DPMCM)

Track Classification: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)