NUS - Italian Graphene Centre workshop 2014 : Talks Schedule

Time	Monday, March 17	Tuesday, March 18
8:30 - 9:00	Opening by Prof Antonio Castro Neto (NUS)	
9:00 - 9:45	Prof Vittorio Pellegrini (ITT)	Prof Antonio Castro Neto (NUS)
9:45 - 10:30	Prof Slaven Garaj (NUS)	Prof Iwan Moreels (IIT)
10:30 - 11:00	Coffee Break	Coffee Break
11:00 - 11:45	Prof Marco Polini (IIT)	Prof Shaffique Adam (NUS)
11:45 - 12:30	Prof Vitor Pereira (NUS)	Prof Camilla Coletti (IIT)
12:30 - 14:30	Lunch	Lunch
14:30 - 15:15	Prof Alberto Diaspro (IIT)	Discussion and conclusions
15:15 - 16:00	Prof Hyunsoo Yang (NUS)	
16:00 - 16:30	Coffee Break	
16:30 - 17:15	Prof Christian Nijhuis (NUS)	
17:15 - 18:00	Prof Elbert Chia (NTU)	
18:00 - 19:00	Visit to GRC facilities	
20:00	Dinner at Blueginger Restaurant *[for speakers]*	

Time	Monday, 17th March 2014
8:30 - 9:00	Opening by Prof Antonio Castro Neto (NUS)
9:00 – 9:45	**Graphene for energy: an overview** *Vittorio Pellegrini (IIT)* Energy conversion and storage are two of the grand challenges that our society is facing. In this talk I shall review recent progresses on the application of graphene, related two-dimensional crystals, and hybrid systems for energy conversion focussing in particular to batteries and hydrogen storage. The versatility of graphene and related materials can lead to new power management solutions for portable and flexible devices, as well as integration in living environments. I shall outline the roadmap for future applications.
9:45 - 10:30	**Single-molecule DNA detection using graphene nanopore device** *Slaven Garaj (NUS)* In a "nanopore microscope", individual DNA molecules in salt solution are pulled through single nanometre-scaled pore, allowing for sequential parts of the molecule to be interrogated within the pore. Here, we will present graphene nanopore device, which has potentials to detect features along a DNA molecule with the resolution comparable to nearest neighbour nucleobase distance. We will discuss different modes of DNA detection within the pore, involving electrical and ion-current signals.
10:30 - 11:00	Coffee Break
11:00 - 11:45	**How lossy is graphene plasmonics?** *Marco Polini (IIT)* In this talk I will highlight the subtle difference between plasmon lifetime and Drude transport scattering time. I will present microscopic calculations of plasmon damping rates in single-layer graphene by taking into account electron-disorder,electron-phonon, and electron-electron scattering mechanisms.

11:45 - 12:30	**Tailoring electronic properties of 2D crystals by strain engineering** *Vitor M. Pereira (NUS)* Graphene has taught us that the intrinsic electronic properties of two-dimensional crystals can be molded by many more, and much richer, approaches that can be applied to 3D bulk solids. One of them results from graphene's exceptional range of elastic deformation, complemented by an unusual electron-phonon coupling that can be captured by the concept of a fictitious or pseudo-magnetic field (PMF). Hence, the ability to manipulate the strain distribution in graphene opens the enticing prospect of strain-engineering its electronic and optical properties, as well as of enhancing interaction and correlation effects. I will describe some examples of how strain-engineered graphene can have richer spectral, transport, and optical properties, or how it allows potentially novel device functionalities and tunability. Some concepts will be discussed in parallel with a summary of their recent experimental reproduction. Finally, a general optimization framework for tailoring physical properties of two-dimensional electronic systems by manipulating the state of local strain, allowing a one-step route from their design to experimental implementation will be presented.
12:30 - 14:30	Lunch
14:30 - 15:15	**Nanobiophotonics links to graphene platform** *Alberto Diaspro (IIT)* Optical Nanoscopy and super resolution microscopy revolutionized the access to information related to the study of biological systems and organic/inorganic matter. Such a possibility is enhanced by the utilization of fluorescent probes. I will discuss the state of the art of the optical techniques related to the possibility of enhancing fluorescent properties of labels and/or of fluorescence detection by means of graphene. Moreover, since part of our studies are devoted to super resolution on cell aggregates, I would like to propose an activity related to the preference of tumoral cells to aggregate in presence or absence of graphene. Such a condition can be studied at the molecular level by means of nanobiophotonics approaches as the ones we developed at IIT.
15:15 - 16:00	**Optical and electrical graphene device applications** *Hyunsoo Yang (NUS)* In this talk, I will discuss the various (opto)electronic graphene device applications. We report the tunable resonance wavelength of localized surface plasmon by varying the distance between graphene and Au nanoparticles. A liquid crystal based THz phase shifter and an ion gel based THz modulator with the graphene films as transparent electrodes are demonstrated. We also show a hysteresis in the conductance and capacitance can serve as a platform for graphene memory devices. A few sensor applications will be discussed as well.
16:00 - 16:30	Coffee Break

16:30 - 17:15	**Quantum Plasmon Resonances Controlled by Molecular Tunnel Junctions** *Christian A. Nijhuis (NUS)* During the talk I will discuss our recent progress in the development of molecular tunnel junctions based on self-assembled monolayers (SAMs) and how we apply them as electrical excitation sources of plasmons. We form SAM-based molecular junctions using top-electrodes of a non-invasive liquid-metal that forms stable features in microchannels. This liquid-metal alloy (a mixture of Ga and In stabilized by a conductive 0.7 nm thick layer of GaO_x) forms good electrical contacts with SAMs.[1] I will briefly discuss our efforts in understanding the role of defects (induced by the electrode that supports the SAMs) on the device characteristics and how they can be minimized.[2-4] The second part of the talk I will introduce our ongoing efforts in using SAM-based junctions as electrical excitation sources for plasmons. The molecular electronic plasmon sources also make it possible to study the dynamic behavior of junctions close to their electrical break down voltage. Finally, I will describe the direct observation of and control over quantum plasmon resonances at length scales in the range of 0.4 – 1.3 nm across molecular tunnel junctions made of two plasmonic resonators bridged by self-assembled monolayers (SAMs).[5]
17:15 - 18:00	**Terahertz conductivity of Dirac-like materials** *Elbert Chia (NTU)* In this talk I will discuss terahertz conductivity results of two Dirac-like materials using terahertz time-domain spectroscopy, as a function of temperature in the frequency range 0.3 – 3 THz. In twisted bilayer graphene, on top of a Drude-like response, we see a strong peak in the real conductivity $\sigma_1(\omega)$ at ~2.7 THz. We analyze the overall Drude-like response using a disorder-dependent (unitary scattering) model, then attribute the peak at 2.7 THz to the presence of van Hove singularities arising from a small-angle commensurate twisting of the two graphene layers [1]. In the three-dimensional topological insulator $Bi_{1.5}Sb_{0.5}Te_{1.8}Se_{1.2}$, the complex conductivity was analyzed using the Drude-Lorentz model [2]. By calculating the Drude spectral weights of the sample, we found, compared to other bismuth-based topological insulators, that the topological surface states are more clearly discerned with the three-dimensional bulk states being suppressed.
18:00 - 19:00	Visit to GRC facilities
20:00	Dinner at Blueginger Restaurant *[for speakers]*

Time	Tuesday, 18th March 2014
9:00 - 9:45	Prof Antonio Castro Neto (NUS)
9:45 - 10:30	**Fluorescent Colloidal Quantum Dots for Opto-Electronic Applications (on a Graphene Platform)** *Iwan Moreels (IIT)* Colloidal quantum dots can nowadays be synthesized with high quantum efficiencies (up to 90%), controlled emission wavelength from the blue (400 nm) to the near-infrared (3000 nm), and with exciton lifetimes ranging from 100 ps to over 1us. In this talk I will highlight some of the applications that we explore with these materials, and discuss the role that graphene could play, as a flexible and transparent charge-transport layer.
10:30 - 11:00	Coffee Break
11:00 - 11:45	**Graphene minimum conductivity -- a tale of disorder, interactions and quantum interference** *Shaffique Adam (NUS)* The complex interplay between disorder, electron-electron interactions and quantum interference is an interesting backdrop to many of the unsolved mysteries in condensed matter physics. In this talk I will discuss graphene close to charge neutrality, where the energy landscape becomes highly inhomogeneous, forming a sea of electron-like and hole-like puddles. Here, the electronic properties of the Dirac point provide an intriguing example of how the competing effects of disorder, electron-electron interactions, and quantum interference conspire together to give a surprisingly robust state whose properties can be described using semi-classical methods.
11:45 - 12:30	**Growth, characterization and tailoring of large area graphene: from epitaxial graphene on SiC to CVD graphene** *Camilla Coletti (IIT)* In this talk I will discuss the different growth processes used to obtain large area graphene on SiC crystals and Cu foil. Characterization of the morphological, chemical and electronic properties performed with different spectroscopic and microscopic techniques will be presented. Molecular functionalization and atomic intercalation techniques will be also discussed.
12:30 - 14:30	Lunch
14:30 - 15:15	Discussion and conclusions
15:15 - 16:00	