Lecture 2:

Title: Wearable Printed Graphene Sensors

Abstract:
Graphene is a material with outstanding mechanical and electrical properties, making it the strongest, thinnest and most conductive material. The prospects of exciting opportunities have spurred an immense interest. However, in terms of economic impact it has yet to live up to the revolutionary expectations. The main challenge for the translation of graphene into competitive products is the scaling up of an efficient graphene production process.
Recently, it has been discovered that graphene can be fabricated by a laser printing process on polyimide films. This method maintains many desirable features and combines them with an efficient fabrication process on a flexible and lightweight substrate. This offers new prospects for the realization of sensors that are robust, wearable, bendable and can operate in corrosive or high temperature environments.
Laser-induced graphene features a large surface, rendering it very attractive for chemical sensing. Its piezoresistive properties can be exploited for wearable resistive bending sensors that are the basis for a sensor family to measure force, flow, deflection, pressure, temperature or curvature. Since graphene can be printed on both sides of polyimide substrates, temperature compensation can be obtained and an operating range up to around 400 deg. C can be achieved for flexible sensors. The corrosion resistance of graphene is another important property, which can be utilized to realize salinity sensors. Together with temperature and pressure sensors, a conductivity, temperature and depth sensing system can be printed on one substrate, which is a fundamental device for marine observations.
We have studied the performance of printed graphene sensors in various applications, including tracking of body movements, underwater monitoring, magnetic field sensing, animal monitoring, magneto-hydrodynamic pumping, or tactile sensing to name a few.
The versatility in the sensor design, biocompatibility and flexibility make printed graphene sensors an attractive option for wearable devices, ubiquitous sensor networks or smart cities. The simple fabrication process allows users to rapidly develop new sensor solutions.