MECHANICAL ENGINEERING

The Department of Mechanical Engineering presents:

The Ph.D. Dissertation Defense of:

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Characteristics of Graphitic Films for Carbon based Magnetism & Electronics

This dissertation concentrates on the characteristics of the graphene: single layer of graphite which is defined as two-dimensional material for carbon based magnetism and electronics. Carbon materials, which are demonstrated by diamond and graphite, have always been of great interest for their unique properties. Moreover, in the last two decades, there have been three revolutionary milestones in the development of carbon materials, which were related to the discovery of fullerenes, carbon nanotubes, and graphene, respectively. Such research evolution led to the realization of the feasibility to tailor magnetic and electronic properties of graphiticsheets.

Meanwhile, magnetism of carbon materials is of particular interest because of its new and relatively unexplored origins. The technological potential of the new materials is enormous as they promise to become the first room-temperature ferromagnetic semiconductors – the holy grail of the world of electronics. Not to mention that the existence of the new materials is vital for the emerging field of spintronics. Researchers are convinced that the new carbon-based magnetic materials could greatly extend the limits of current technologies relying on magnetic and semiconductor properties. In this work, the magnetic properties of pristine graphene and chemically modified graphene were mainly studied. The chemical functionalization was performed by covalent attachment of aryl groups to the basal plane of carbon atoms. This chemical modification with nitrophenyl (NP) groups was formed by covalent bonding to the conjugated carbon atoms. The functionalized samples were found to be in a mix of ferromagnetic and antiferromagnetic states with spins aligned in the main plane at room temperature. Based on the findings, this work studies the origins of the intrinsic magnetism and potential ways to tailor magnetism in graphene. In conclusion, this technology has great potential to pave a way to the next-generation technologies of high-speed and high-density nonvolatile memory, reconfigurable logic devices, computing, integrated magneto-optical devices, quantum information devices, and many others.