## **MRSEC SEMINAR SERIES**

Northwestern University Materials Research Center

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## 1D and 2D Heterostructures: Detailed Structural and Local Spectroscopic Studies via TEM

In the last two decades, transmission electron microscopes (TEM) have undergone a large number of improvements allowing few meV energy resolutions for a sub-angstrom electron beam. These performances offer new possibilities for probing the optical, dielectric and electronic properties of nanomaterials with unprecedented spatial information, as well as for studying the atomic configuration of nanostructures. I will present a selection of recent works taking advantage of these new capabilities [1-12]. These works will concern the study of the atomic structure & configuration of nanostructures (including doped carbon nanotubes, and other 2D materials (graphene oxide (GO), transition metal dichalcogenides (TMDs)), as well as opto-electronic properties studies carried out via electron energy loss spectroscopy (EELS) measurements of different kind of low-dimensional materials (inorganic nanotubes and metallic nanoparticles). These works will illustrate the study of properties with extreme spatial resolution enabled by a Cs probe corrected STEM combined with the use of a monochromator.

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Dr. Raul Arenal is a Senior ARAID Resarcher at the Institute of Nanoscience and Materials (INMA), CSIC-U. Zaragoza (Spain) and Leader of the Nanoscopy on Low Dimensional Materials (NLDM) group at the INMA. In 2007, he became research scientist at the CNRS (France, now on leave). He is the Coordinator of the TEM area of the Laboratorio de Microscopias Avanzadas (LMA), U. Zaragoza. Dr. Arenal has published more than 250 papers in refereed journals (http://www.raularenal.com) and edited one book (Springer). Arenal's broad area of research interest lies in electron microscopy focused on materials science and nanoscience. These studies are mainly focused on the growth mechanism, structural and physical properties of low dimensional materials based on carbon, boron and nitrogen as well as other nano-structures (in particular, metallic nanoobjects for plasmonic/photonic interest). Among his scientific activities, Dr. Arenal is the chair of the HeteroNanoCarb conference series (http://heteronanocarb.org) focused on graphene, NT and related 1D-2D nanomaterials. Dr. Raul Arenal received his Ph.D. in Solid State Physics from Univ. Paris-Sud (Orsay, France, 2005) and in 2013, he obtained his Habilitation (HDR) also at this University. From April 2005 to August 2007, he joined the Electron Microscopy Center in Argonne National Laboratory (ANL, USA) as post doctoral fellow. In 2007, he became research scientist (Chargé de Recherches) at the CNRS (France), working at the LEM, CNRS-ONERA (Chatillon, France). From September 2010 to December 2011, he was visiting scientist (sabbatical position) at the LMA, Universidad de Zaragoza (Spain). Since 2012, Dr. Arenal is on leave from the CNRS, and he is currently ARAID research scientist at the LMA-INMA-Universidad de Zaragoza.



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Monday, Dec. 5, 2022 Ryan Hall, 2190 Campus Drive, #4003 11:00 a.m.-12:00 p.m.