Aalto University

Dissertation press release 11.03.2020

Graphene Nano flakes can grow without any substrate

Title of the dissertation	Aerosol CVD synthesis and applications of single-walled carbon nanotube thin films using spark-discharged produced catalyst
Contents of the dissertation	The catalyst particle that seeds the growth of single-walled carbon nanotubes (SWCNTs) is one of the most important parameters determining the morphology and chirality of as-synthesized SWCNT. The development of the spark discharged based floating catalyst chemical vapor deposition technique in the present thesis has enabled decoupling of the catalyst and SWCNT formation into two consecutive processes. We employed various spark discharge produced catalyst particles to investigate the roles of catalyst composition on various growth characteristics of SWCNTs. Moreover, we found that the addition of sulfur promoter in the growth process of SWCNTs enhances the performance of SWCNT-based transparent conductive films, which are an appealing material for the replacement of indium-doped tin oxide in emerging flexible, bendable and stretchable display devices. In addition, we have developed a novel gas-phase, single step and substrate free method for the simultaneous growth of 0D-fullerene, 1D-SWCNTs and 2D-graphene. Fullerene and SWCNTs arise from graphene through selective removal of atoms that force the 2D-sheet into a 1D-tubular or 0D-spherical configuration. In this thesis, we demonstrate that under a carefully chosen gas atmosphere along with SWCNTs and fullerenes that have been synthesized in similar processes graphene flakes emerge within the gas-suspension and grow to a size of up to several hundreds of nanometers without folding or crumpling. Our technique paves the way for the direct deposition of the hybrid material onto any surface at ambient temperature with an arbitrary thickness. This offers a new route towards ultra-fast manufacturing of the hybrid material at an industrial scale.
Field of the dissertation	Engineering Physics
Doctoral candidate	Saeed Ahmad, MPhil
Time of the defence	17.04.2020, time 12:00 pm
Place of the defence	Aalto University School of Science, lecture hall T1, Computer Science building, Espoo.
Opponent	Professor Thomas Wågberg, Umeå University, Umeå, Sweden.
Custos	Professor Esko I. Kauppinen, Aalto University School of Science, Department of Applied Physics.
Electronic dissertation	http://urn.fi/URN:ISBN:978-952-60-3796-7
Doctoral candidate's contact information	Saeed Ahmad, Department of Applied Physics, saeed.ahmad@aalto.fi and +358 50 4683244