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Microporous Carbon Frameworks For Gas and Energy Storage Applications

Tuesday, April 19 | Bldg. 101
4 PM | Seminar room on the 1st floor

Microporous polymers attracted [1] significant deal of attention in recent years due to their permanent porosity, chemical tunability, physicochemical stability and exceptional gas sorption properties.[2] Incorporation graphene nanoribbons (GNRs) or graphene sheets into microporous polymers, however, has been a significant challenge mainly due to their low solubility and high affinity to restack to form graphitic layers due to interlayer π - π stacking and van der Waals interactions. Graphene is composed of single-atom-thick, sp^2 hybridized carbon atoms that are bonded together in a two-dimensional (2D) hexagonal honeycomb lattice, and presents high π -surface area, excellent chemical, thermal, mechanical stability along with superior thermal and electrical conductivities. Importantly, the resulting microporous polymers incorporating either graphene or GNRs are expected to inherit some of their unique properties. In order to prevent restacking and to take full advantage of high π -surface area, we proposed to introduce a permanent 'spacer' such as porosity between GNRs and graphene layers within the microporous polymers. We utilized both noncovalent [2] and covalent [3] approaches to form three-dimensional graphene frameworks. Recently, we also utilized [4] bottom-up approach to introduce graphene nanoribbons up to 2 nm in length and 1.1 nm in width into graphene nanoribbon frameworks (GNFs). These framework showed high thermal stability up to 400oC in air with relatively narrow pore size distribution and exhibited BET surface areas up to 700 m² g⁻¹ and promising gas separation properties. More recently, in effort prepare 3D all sp^2 -hybridized carbon frameworks, we utilized highly preorganized monomers with curvature to form the corresponding carbon frameworks. These materials have been shown to be excellent electrochemical catalyst for the hydrogen evolution reaction and also utilized as supercapacitors for energy storage applications.

[1] Patel, H. A.; Je, S. H.; Park, J.; Chen, D. P.; Jung, Y.; Yavuz, C. T.; Coskun, A., Nature Commun., 2013, 4, 1357.

[2] Talapaneni, S. N.; Hwang, T. H.; Je, S. H.; Buyukcakir, O.; Choi, J. W.; Coskun, A., Angew. Chem. Int. Ed., 2016, DOI: 10.1002/anie.201511553. (Selected as Very Important Paper)

[3] Srinivasan, S.; Je, S. H.; Back, S.; Barin, G.; Buyukcakir, O.; Guliyev, R.; Jung, Y.; Coskun, A., Adv. Mater., 2014, 26, 2725–2729.

[4] Song, K. S.; Coskun A., ChemPlusChem, 2015, 80, 1127–1132. (Early Career)

You are cordially invited to attend!

Tuesday Colloquium