Interfacial Science and Engineering of Highly Surfaceous Carbons

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The geometrical surface area of graphene and single wall carbon nanotube (SWCNT) is 2630 m^2/g; highly activated carbon has a large surface area of more than 2630 m^2/g. Furthermore, SWCNT and activated carbon have nanoscale pore spaces having unique functions such as in-pore superhigh pressure effect and storage of supercritical gases. These surface-dominant carbons have unique interfacial functions.

This presentation introduces non-Coulombic structure of ionic liquid confined in pores of activated carbon (1), highly selective nanowindow design of graphene for air separation (2), and application potential of Zn-Al sol-gel chemistry derived- highly stable SWCNT inks (3) to new technologies.

1:The structure of Ionic liquid, EMI-TFSI , confined in 0.7 nm slit-shaped pores of carbide-derived carbon was studied with hybrid-reverse Monte Carlo simulation-aided X-ray scattering. We evidenced the accumulation of EMI cations and TFSI anions in the pores due to the reduced repulsive interaction through the image charge effect. This understanding accelerates design of better supercapacitors.

2: The subnanoscale window whose rim has quantum chemically-stable oxygen groups is created in graphene. The molecular penetration rate of N_2, O_2, and Ar through the nanowindow whose size is in the range of smaller than the target molecule to larger than the target one was evaluated with molecular dynamics. The concerted penetration mechanism supported by the rim motion can give extremely high selective penetration rate, showing a promising air separation route.

3: We developed unique sol-gel derived Zn-Al dispersant for SWCNT. The dispersion treatment with Zn-Al dispersant does not form foams, as observed in surfactants. The Zn-Al dispersant provides a quite stable SWCNT ink whose dispersion stability keeps more than 1 year. The Zn-Al dispersant gives transparent conducting film of sufficient flexibility and highly conductive stretchable electrodes.

Keywords: single wall carbon nanotube, nanowindow, graphene, activated carbon, ionic liquid, supercapacitor, air separation, dispersant, conducting film