# Role of Porosity in the Hygroscopic Nature of Nanodiamonds

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Detonation nanodiamonds (ND)s are found as aggregate structures (50-500 nm) of polyhedral particles of $sp^3$ hybridized carbon atoms of 4-5 nm in diameter,[1] with an inert ND core and a chemically active graphitic surface. These aggregates have inter-granular gaps. Wettability towards water can be associated with water vapor adsorption and hygroscopic tests. This work analyzed the dependency of wettability of ND disks (hard hydrogel; Nano-Carbon Research Institute, Ltd., Japan) on their hierarchical porosity by adsorption of water vapor (298 K) and absorption of liquid water at room temperature.

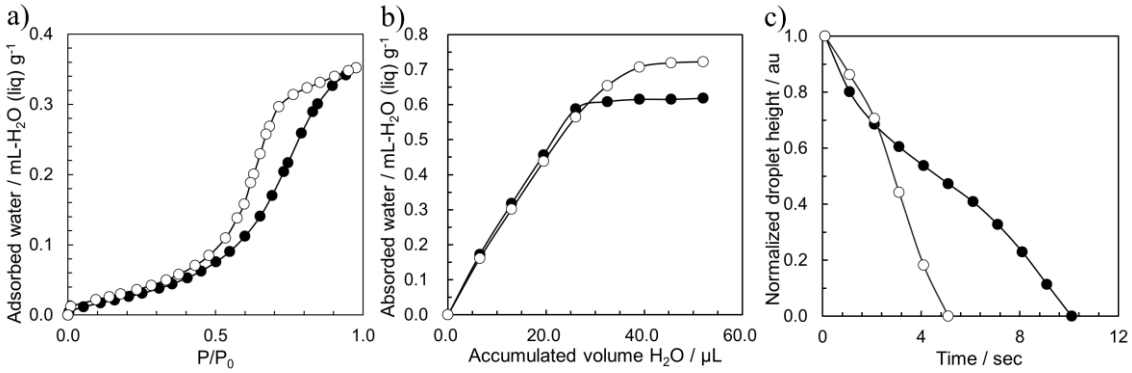


**Fig. 1**. a) Water vapor adsorption isotherm (298 K), b) absorption of water droplets and c) kinetics of water droplet absorption on ND disks. In a) ● and ○ denote adsorption and desorption branches, respectively. In b) and c) ● and ○ denote densities of ND disks of 1.6 and 1.4 g $cm^{-3}$, respectively.

The water adsorption isotherm indicates that NDs are hydrophobic porous materials with the presence of hydrophilic sites. Hygroscopicity test reveals that water droplets are absorbed up to filling ~84% and ~67% of void space of ND disks of densities of 1.4 and 1.6 g $cm^{-3}$, respectively. Interestingly, NDs exhibit intensive hygroscopic property in spite of the hydrophobicity in the molecular level. The micropores in NDs triggers the adsorption of water molecules and both of micropores and small mesopores (< 6 nm) promote high absorption of water.[2] Moreover, the hydrophilic sites of the NDs shell are key for their wettability because oxygen-containing functional groups in those pores and curvature of such cavities allow the attraction of water molecules that fill the pores.

## Reference

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