CAMT Seminar

"Surface modification of natural zeolites using gas discharges"

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Center for Atomic and Molecular Technologies (CAMT)
(A12 棟 1 階会議室)

Abstract:

Zeolites are microporous and mesoporous minerals made of crystalline aluminosilicates with a three-dimensional framework of tetrahedral molecules. For several years, these materials have been used in different technologically important fields due to its high sorption capacity, chemical inertness, and thermal stability. Thus, zeolites find applications as ion exchangers, catalysts, and adsorbents. The elementary building units of zeolites are SiO4 and AlO4 tetrahedra, which are linked at the corners by a shared oxygen atom. This creates a framework that contains channels, channel intersections, or cages with dimensions ranging from 0.2 to 1 nm. With its high ion-exchange capacity coupled with its shape-selective structure, zeolites are also used as "molecular sieves." Zeolites may occur naturally or produced synthetically. Clinoptilolite, mordenite, phillipsite, chabazite, stilbite, analcime, and laumontite are common forms of zeolites. While synthetic zeolites have tunable and predictable properties, natural zeolites mined from different parts of the world have impurities such as quartz or inorganic minerals which requires pretreatment before it can be utilized. In the Philippines, natural zeolites are used in different industries due to its local abundance. Pretreatment of natural zeolites are usually done in a sodium chloride solution to improve its ion exchange capacity. Then additional treatments may be necessary depending upon its target application. In our laboratory, we have utilized plasma-based processes to modify natural zeolites for different applications. Recently, we enhanced the heavy metal adsorption capacity of plasma-treated zeolites using hexavalent chromium as model pollutant [1]. Exchanging the cations in the framework with other metals can be achieved using facile impregnation of the solid support. At the same time, the ions retain the properties of the metal while the zeolite provides a stable template. For instance, copper (Cu) and silver (Ag) ions were successfully exchanged in the zeolite while retaining the antibacterial properties of Cu and Ag [2,3]. Recently, we utilized plasma to reduce ions impregnated in the zeolite to form nanoparticles embedded in the framework. Plasma exposure was successful in reducing the Ag^+ to metallic form [4] and exhibited higher antibacterial sensitivity [3]. Metal/support systems also find applications as composite filler. Ag-zeolite (AgZ) particles were successfully integrated into a chitosan matrix [5]. Plasma discharges were used to modify the surface of the AgZ-chitosan composites for potential biomedical applications. The plasma-modified AgZ-chitosan composites exhibited antibacterial sensitivity with good cytocompatiblity and good hemocompatibility [6].

[1] C. Cagomoc and M. Vasquez, Jpn. J. Appl. Phys. 56, 01AF02 (2017).
[2] A. Montallana, C. Cruz, and M. Vasquez, ISPLASMA2017, Chubu University, 2017.
[3] A. Osonio and M. Vasquez, Jpn. J. Appl. Phys., submitted.
[4] A. Osonio and M. Vasquez, Appl. Surf. Sci., submitted.
[5] K. Taaca and M. Vasquez, Mesopor. Micropor. Mater. 241, 383-391 (2017).
[6] K. Taaca and M. Vasquez, Appl. Surf. Sci., accepted.

(Host: Satoshi Hamaguchi Ext：7913)