Solid-state and surface chemistry (SSSC)

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The relationship between electronic structure, chemical bonding, and crystal structure as wel as processes that occur at the interface of two bulk phases are developed. Attention are given to characterization of atomic and molecular arrangements in crystalline and amorphous solids: metals, ceramics, semiconductors and polymers. The bulk phases can be of the type solid-gas, solid-liquid, liquid-gas and liquid-liquid. Surface processes such as filtration, adsorption on activated carbon, ion-exchange and reverse osmosis are used in water and waste water treatment. Hence, surface chemistry studies are important since they have many applications. Following topics are discussed:

1. Preparation of selected solid materials (cement, ceramics, glasses, polymers, composites, electronic materials with certain characteristic properties such as ferrites, shift structures causing nonstoichiometry, new ceramic materials with unusual functional properties, and, finally, synthesis of semiconductors and superconductors)
2. Synthesis of polycrystalline or single crystal materials by solid-solid, solid-gas, chemical vapor deposition (CVD) to produce thin films or surfaces, solution hydrothermal, sol-gel, microemulsion, etc., methods
3. Reactivity of solids and role of defects in the mechanism of the solid-state reactions
4. Mass transfer processes in a solid state - Laws determining mass transfer processes when diffusion in solids is accompanied by a chemical reaction
5. Solid-state reactions under extreme conditions (initiation of the processes by electricity, magnetic field, electromagnetic radiation, or mechanical impulse)
6. Characterization using different instrumental and chemical techniques such as XRD, XPS, BET surface area measurement, etc.

Projekt „Rozwój interdyscyplinarnych studiów doktoranckich na Politechnice Gdańskiej w zakresie nowoczesnych technologii” jest współfinansowany przez Unię Europejską w ramach Europejskiego Funduszu Społecznego.

7. Surface phenomena as adsorption, catalysis, formation of colloids, emulsions and micelles and their uses.

The program includes 12h of lecture and 3h of laboratory session. The laboratory sessions are run in small groups of 3-4 students and include BET surface area measurement (for porous materials) and band gap measurement (for nanocrystalline semiconductor).

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