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| הפקולטה להנדסה כימיתע"ש וולפסון |  |  |
| The Wolfson Department of Chemical Engineering |  |  |

**Wolfson Department of Chemical Engineering Seminar**

**Wolfson Department of Chemical Engineering, Lecture Hall No. 6**

**Wednesday, August 18th, 2021, at 13:30**

**The correlation between the photoactivity of photocatalysts and the tensorial properties of the effective mass of their charge carriers**

**Eitay Shtayinberg**

Department of Chemical Engineering, Technion-Israel Institute for Technology

**MSc Seminar**

Advisor: Prof. Yaron Paz

The potential of photocatalysis is well known and has been studied intensively. photocatalysts may be used for water splitting, conversion of solar energy to electricity, conversion of CO2 to fuel, and decontamination of water, air, and surfaces. When a photocatalyst absorbs a photon, generation of charge carriers occurs. The excited electron and the hole diffuse to the surface to perform redox reactions, or might recombine and annihilated. The photoactivity of a photocatalyst depends on many coupled parameters. Consequently, the large diversity in terms of efficiency among the many types of photocatalysts is far from being understood. In this study we suggest a correlation between the tensorial properties of the effective masses of the charge carriers and the photoactivity of photocatalysts. The BiOX (X= F, Cl, Br, and I) family of materials was chosen as a first model system. Micrometric single crystals of these materials were synthesized by microwave assisted synthesis. The crystals were fixed on a self-manufactured micro-electrodes made by us under clean room conditions. Two measurement modes were developed in the clean rooms, the first one is based on two parts: one functions as a fixing device and the second as the measuring electrode and as an optical window that allows the crystal to be illuminated only through a 5 μm hole. The other setup is made of one integrated device, which functions as both the measuring electrode and the fixing device. In this setup the whole crystal is illuminated. Integrating the measuring of photoinduced electrical currents at different conditions (different electrodes, different bias voltage) with the characterization of the directions in the crystals, and the calculated effective masses' tensors for the BiOX materials will, hopefully, allow us to construct a general parameter which will enable to confirm or to negate our hypothesis.

**Refreshments will be served at 13:15**

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**Wednesday, August 18th, 2021, at 13:30**

**Selective Photocatalytic Degradation of Hydrophobic Compounds in Aqueous Medium**

**Omri Toker**

Department of Chemical Engineering, Technion-Israel Institute for Technology

**MSc Seminar**

Advisor: Prof. Yaron Paz

The presence of pesticides, hormones and antibiotics in wastewater is currently of large concern due to the damage they can cause to the ecosystem, even at miniscule amounts. Generally, most water treatment techniques are unable to efficiently remove these compounds, and a lack of regulation in the matter hinders their development.

The ability of photocatalysts to mineralize organic compounds is well-documented. Of which, due to its favorable chemical and environmental properties, titanium dioxide (TiO2) is the world’s most widely used photocatalyst. Like most transition metal oxides, TiO2 is a highly hydrophilic material, which allows it to easily adsorbs polar contaminants, but also prevents it from efficiently adsorbing hydrophobic molecules.

Unfortunately, many of the biochemical compounds mentioned above are highly hydrophobic. Therefore, it is necessary to modify TiO2 so that it is better suited to degrade hydrophobic compounds. Such a coating must be impervious to photodegradation, so that it would not be degraded by the TiO2.

Rare earth oxides (REO), a colloquial term for oxides of elements from the Lanthanide series (Lanthanum to Lutetium), have been described in several works to be quite hydrophobic. This sets them apart from most metal oxides, which are in general quite hydrophilic. Incorporating these REOs into the TiO2 photocatalyst, even in small amounts, should therefore promote adsorption of hydrophobic molecules to the surface, improving photocatalytic activity. REOs are also extremely resilient, both chemically and physically, and would not be degraded by photocatalytic chemical reactions.

In this work, silica plates were coated with several different types of REO-doped SiO2-TiO2 layers via spin coating, and their ability to degrade ciprofloxacin, a highly hydrophobic antibiotic, was tested. The different types’ photocatalytic ability was compared to each other, and also compared with their displayed photocatalytic degradation of caffeine, a highly polar molecule.

An increase in the photocatalytic degradation constant of caffeine and ciprofloxacin by up to 40% and 90%, respectively, was reached by one type of coating. An increase in the selectivity (the ratio between the constants) of up to 140% was reached by another type of coating.

**Refreshments will be served at 13:15**