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

**Wolfson Department of Chemical Engineering Seminar**

**Wednesday, June 16th, 2021 at 13:30**

**Lecture Hall No. 6**

**Physical Properties of Colloidal Layered Double Hydroxides (LDH)**

**Mais Khaskia**

Department of Chemical Engineering, Technion-Israel Institute for Technology

**MSc Seminar**

Advisors: Prof. Ofer Manor & Prof. Oz M. Gazit

Layered double hydroxides (LDH) are two-dimensional nanostructured anionic clays that have attracted considerable attention for their special lamellar shape, ion exchange capacity and chemical stability. While the stability and behavior of dispersions of spherical colloidal particles are by now reasonably well understood, the picture is much less clear in the case of lamellar colloids.

We study the physical properties of LDH nano-particles with plate-like structure. We concentrate on their contribution to the acidity of the overall colloidal suspension, surface charge in terms of zeta potential, and the rate of particle coagulation under different conditions. We observe that the particles buffer their environment over time, rendering the latter basic even if the initial state of the suspension is highly acidic. The zeta potential (surface charge) of the particles in an acidic solution is measured to be positive and largely independent of the solution pH. However, under basic conditions, the magnitude of the positive zeta potential at the surface of the particles decrease with the increase in pH. At sufficiently high pH levels, the zeta potential traverses the point of zero charge (PZC), which yields negative zeta potential levels and particle sedimentation.

We further observe that the coagulation rate of LDH particles increases with pH levels in connection with the level of acidity. interestingly there is no agreement between the rate of particle coagulation at short times and the Smoluchowski theorem for the rate of particle coagulation. The latter is based on DLVO and hydrophobic/hydrophilic interactions in the suspension. The mismatch is likely associated with the structural mode of interparticle attachment of the particles in solution. Cryo-TEM observations show that the 2D particles have a clear preference to attach to each other through their narrow sides. This correlates well with the different surface chemistry of the particle at their narrow sides as compared to the top surface of the particle. Hence this mismatch is also associated with the fact that the values of the zeta potential were measured for the top surface and hence yields predictions that are inconsistent with observation. Finally, the coagulation of particles is found to be reversible, which alongside the heterogenous geometry of the particles, suggests the opportunity of fabricating a pH-controlled colloidal gate for mass transport involving LDH particles.

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

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**Wolfson Department of Chemical Engineering Seminar**

**Wednesday, June 16th, 2021 at 13:30**

**Lecture Hall No. 6**

**Novel ex-situ technique to measure the chemical stability of anion-exchange membranes simulating in-operando AEMFC test environment**

**Saja Haj Bsoul**

Department of Chemical Engineering, Technion-Israel Institute for Technology

**MSc Seminar**

Advisor: Prof. Dario R. Dekel

One of the major barrier in the development of anion-exchange membrane fuel cells (AEMFCs) is the limited chemical stability of anion exchange membranes (AEMs), since they usually undergo alkaline degradation at fuel cell operating conditions. The existing *ex situ* stability testing methods in the literature do not allow for a reliable measurement of *operando* AEM stability, as they do not mimic the proper environment in an operating AEMFC. Today’s current stability test protocols consist of long-term soaking of AEMs in KOH aqueous solutions. Different conditions are used for these characterization methods, making it difficult to compare the stability values reported in the literature. Most importantly, this KOH solution soaking method leads to false results because: (a) Different AEMs absorb liquid KOH electrolyte differently; (b) Carbonation occur during the various experimental steps if CO2 is not rigorously excluded; (c) K+ counter-ions are present, unlike in an operating AEMFC; and mainly, (d) The AEMs are being degraded under maximum hydration conditions, which is absolutely not the case and not comparable to the AEMFC *operando* conditions. All of these give a false picture of degradation rates, guiding polymer chemist researchers to solve the wrong problems.

This research reports a novel *ex situ* method for determining the alkaline stability of AEMs under conditions that mimic the fuel cell operating environment. We demonstrate the suitability of our technique to determine the alkaline stability of AEMs with different cationic functional groups and polymer backbone chemistries. The developed method provides a unique *ex situ* protocol to measure AEM stability that gives a reliable picture of the real *in situ* alkaline stability. This technique is now being adopted by the leading researchers in the community, and promises to be a game-changer in the degradation analysis of AEMFCs.

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