OPPORTUNITIES IN DEFECTS ENGINEERING AND HEALING IN ZEOLITES

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Zeolites have been game-changing materials in oil refining and petrochemistry over the last 60 years and have the potential to play the same role in the emerging processes of the energy and environmental transition. Although zeolites are crystalline inorganic solids, their structures are not perfect and the presence of defects sites – mainly Brønsted acid sites and silanols - influences their thermal and chemical resistance as well as performances in key areas such as catalysis, gas and liquid separations and ion-exchange.

In this presentation I will review the type of defects in zeolites and the characterization techniques used for their identification and quantification. Emerging and powerful techniques are now available to locate defects and their further development will most probably add rich information how to tune the properties and performances of zeolites. More specifically, I will focus on silanol (Si-OH) defects located within the micropore structure and/or on the external surface of zeolites. The main approaches applied to engineer and heal defects and their consequences on the properties and applications of zeolites in catalysis and separation processes will be presented. The metal healing where the defects act as ports of entry for novel isomorphous substitution (Mo, W, V…) producing new active sites in zeolites working outside of the comfort zone will be presented.

Defects in zeolites need further exploration, explanation and exploitation as they belong to the "Zeolite Crystal Engineering" toolbox to design the new catalysts and adsorbents required in the energy transition and in applications in emerging fields (biomedical, sensors, nanotechnology).