Consiglio Nazionale delle Ricerche
Istituto dei Materiali per l'Elettronica ed il Magnetismo

SEMINARIO

Sala A, I° Piano | CNR-IMEM, Parma | 18 marzo 2025 | ore 11:30

Narrowband-light-triggered photothermal CO_2 desorption from monolithic sorbents

Blaž Belec
Materials Research Laboratory, University of Nova Gorica

The widespread deployment of Carbon Capture, Utilisation and Storage (CCUS) technology faces many challenges, where high operating costs are one of the main barriers. While significant research is dedicated to more efficient CO_2 sorption, a shortage exists in developing cost-effective desorption methods. The most applied CO_2 desorption method is the temperature swing method (TSM), involving heating the entire reactor > 100 °C for extended periods, resulting in high energy consumption.

An alternative approach to reduce energy demand during desorption is utilising light, which, combined with photothermal (PT) nanoparticles, can be converted into heat. Contrary to TMS, the PT approach allows precise and localised gas desorption due to the material's inherent properties. Since PT nanoparticles display narrow absorption peaks, to achieve maximum PT effect with the lowest given power, precise light sources with concentrated power are required. Still, the main challenge of the PT approach is to reach a temperature > 100 °C for complete CO_2 desorption and long-lasting cyclability.

The Peak Absorption Targeted Photothermal Desorption concept is a novel approach which uses low-energy, narrowband light sources—preferably at wavelengths corresponding to the peak absorption (λ_{max}) of thermally stable photothermal (PT)-active monolithic sorbents—to efficiently desorb CO_2. By optimizing light-to-heat conversion, this approach aims to achieve complete CO_2 desorption with up to 90% less energy consumption compared to traditional thermal management systems (TMS).