SOLAR-ASSISTED DEVELOPMENT OF NANOADSORBENTS FOR THE H_2S/SO_2 CAPTURE FROM BIOGAS

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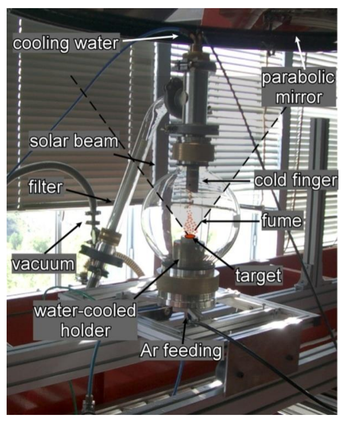
Outline

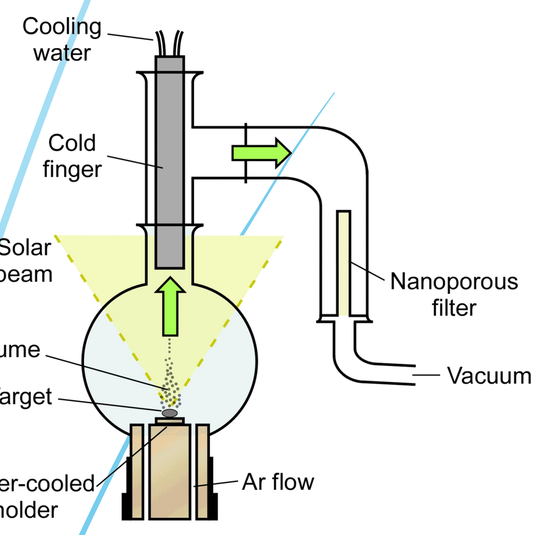
Desulfurization of gas streams through fixed-bed columns filled with $CaCO_3$ has been applied for the elimination of H_2S or SO_2 from flue gases in power stations. The same approach has the potential to remove H_2S from the biogas produced by anaerobic treatment of organic wastes and, therefore, protect the engine and exhaust gas heat recovery equipment from severe corrosion. Succeeding the preparation of surface-activated $CaCO_3$–based products would be an advantageous approach to establish a more efficient desulfurization of biogas especially if combined with the proper processing and upgrade of secondary $CaCO_3$-rich sources such as mussels, eggshells or marble by-products. This study aims both to the development of novel adsorbents with high desulfurization potential through the production of calcium carbonate-based nanoparticles using the solar physical vapor deposition (SPVD) technique, and their evaluation in a laboratory-scale setup.

Experimental

Samples preparation

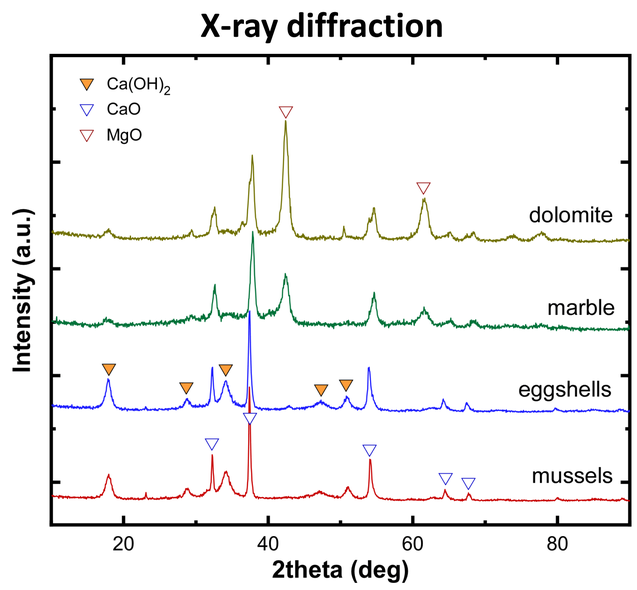
Solar physical vapor deposition using pelletized targets under inert argon atmosphere.
Targets prepared by pressurizing fine powder received from different $CaCO_3$ by-products such as mussel shells, eggshells and mining dusts (marble and dolomite).





PROMES facilities, Odeillo-Font Romeu

Characterization

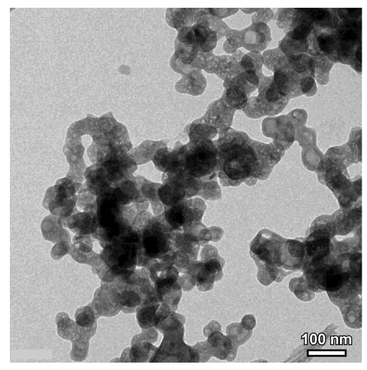


Egg-shell and mussels evaporate consists of CaO and $Ca(OH)_2$.

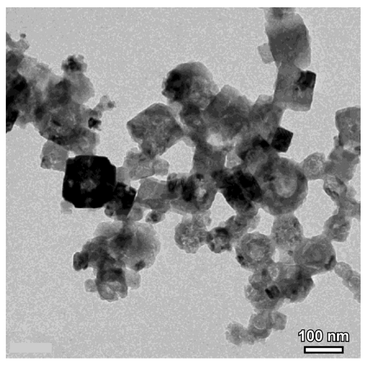
For marble powder the product combines also MgO due to its dolomitic origin.

Hollow aggregated nanoparticles.

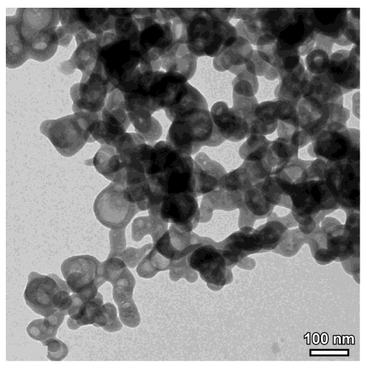
Egg-derived: Spherical 40 nm | Marble-derived: Cubic 80 nm | Mussels-derived: Spherical 70 nm



Egg-shells

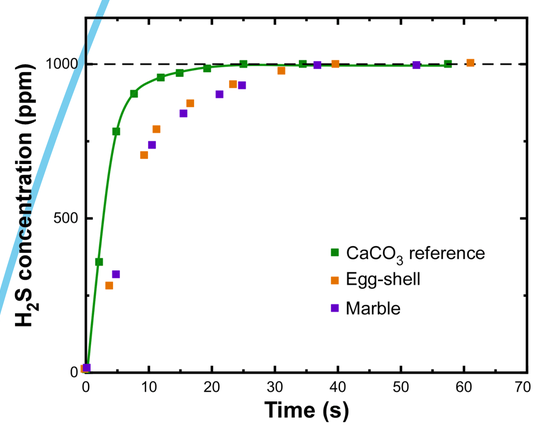


Marble



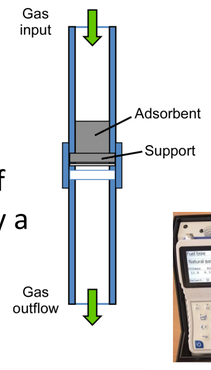
Mussels

Evaluation in H_2S uptake



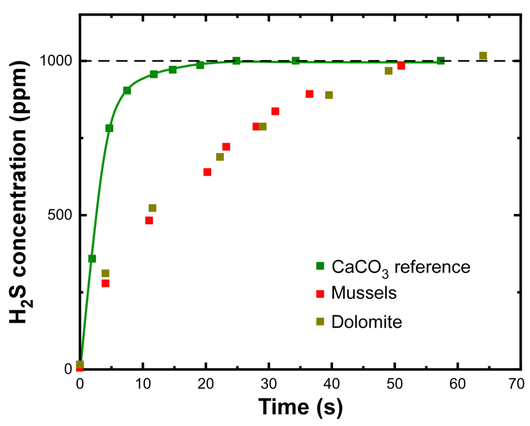
Fixed bed conditions.

Residual H_2S In the outflow of the column was monitored by a continuous gas analyzer.



Ex-situ sequestration of H_2S by placing the nanopowders in a vertical-flow laboratory column.

Mixture of H_2S and nitrogen (1000 ppm H_2S).



- ✓ Egg-shell and marble derived nanoparticles provide a small improvement in H_2S capacity in comparison to bulk $CaCO_3$.
- ✓ Mussels and dolomite ones are able to collect above 0.5 mg/g before saturation.

Uptake capacity (mg H_2S/g)

Mussels	Egg-shells	Marble	Dolomite	$CaCO_3$ ref
0.52	0.22	0.18	0.53	0.08

Conclusions

- Solar physical vapor deposition provides an option to fabricate well-defined nanoparticles from $CaCO_3$ sources.
- Residuals from various activities maybe valorised including mineral and food wastes (egg-shells, mussels).
- Improved specific surface area is the key for the increase of H_2S capture ability.
- High potential for application in biogas desulphurization

Acknowledgments

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