Functionalization of graphene oxide with polyethyleneimine (PEI) and 3-aminopropyltrimethoxysilane (APTMS): CO_2 capture application.

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Fossil fuels are the first reason for climate change and global warming, due to CO_2 emissions. On the other hand, they are versatile energy sources. So, a balance between their drawbacks and benefits is needed.
In the latest years, plenty of works have been developed aimed at the solution of this problem. One of the strategies is reducing CO_2 emission. CO_2 reversible capture and storage, what it is known as carbon capture and conversion (CCC), can be the key to solve it. In this proposal, the gas is captured and stored for its later released and transformation, because in combination with hydrogen (or methane), CO_2 can be transform in high density fuels. These fuels are compatible with any energetic infrastructure of our days [1].
In this context, graphene and its derivatives are shown as the ideal materials for this kind of applications. The main reasons are its 2D structure, high specific surface, and the ability of modify its surface to give them the adequate selectivity.

In the present work amine-functionalized graphene oxide nanoparticles are synthesized. To do so, two different amine molecules were used: polyethyleneimine (PEI) and aminopropyltrimethoxysilane (APTMS), with different reaction methods. These amine groups (-NH_2-, –NH-) provide the material with a CO_2 chemisorption capability. This chemisorption is a reversible reaction between CO_2 molecules and the amine groups of the amino-functionalized graphene oxide surface for the formation of carbamates [2].
The characterization of the result amino functionalized graphene oxide was done by FT-IR spectrometry, DSC and TG as thermal analysis, and mass spectrometry. To evaluate its possible use as in CCC it was used CO_2 adsorption isotherms.

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References

[1] A. T. Najafabadi, Renew. Sustainable Energy Reviews 41 (2015) 1515-1545.
[2] Y. Sánchez-Vicente, L.A. Stevens, C. Pando, M. J. Torralvo, C. E. Snape, T. C. Drage, A. Cabañas, Chem. Eng. J. 264 (2015) 886-898.