Inclusion of Pironine Y in AlPO-5

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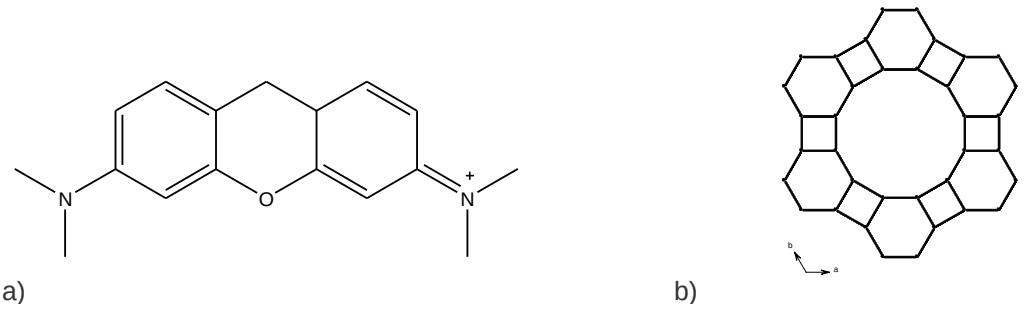
Abstract

The encapsulation of dyes in different inorganic hosts results in composite materials with interesting optical properties. The ordering of the solid matrix imposes the way of aggregation and ordering of the included dye molecule and, therefore, influences the photophysical properties the composite material [1]. The open nature of the structure of zeolites and zeotypes made them very interesting as host materials. The structure of these solids is built by a three-dimensional arrange of corner-sharing tetrahedra characterized by the presence of channels and/or cavities of molecular dimensions, where different molecules can be encapsulated. These materials are usually prepared using organic compounds which are denominated structure directing agents (SDAs) that remain occluded within the structure at the end of crystallization. As dye molecules are not very different to typical SDAs used in zeolite synthesis, this gives the opportunity to study the in situ incorporation of the dye during synthesis of the material. In particular in this work, we have studied the inclusion directly during crystallization of Pironine Y (PY) within AlPO-5 (AFI structure-type material) focusing on the influence of different paremeters.



a) b)

Figure 1 *a) Molecule of Pironine Y and b) channel of AlPO-5*

The big pore material AlPO-5 (AFI) possesses a structure with channels running along one direction (the *c* axes of the structure). The windows that give access to the pore system are delimited by twelve tetrahedra and the dimensions of the channel system are 7.3x7.3 Å

Initially, magnesium aluminophosphate materials were prepared with different SDA as for example triethylamine or tripropylamine, with and without the addition of the dye molecules. Various synthesis parameters were studied as the amount of magnesium and SDA added to the gel. The products obtained were characterized by XRD, TGA, CHN analysis. In the presence of the PY dye, slightly pink in colour AlPO-5 needle-like crystals were obtained as the main product of crystallization with morphology and crystal size similar to those obtained for those prepared in the absence of dye molecules.

Incorporation of the dye in the materials was assessed by fluorescence microscopy. By polarization experiments the adsorption of dye molecules into the internal channels of the aluminophosphate material are checked. Due to the constraints imposed by the framework, the dye molecules should be internally adsorbed mainly along the direction of the main axis of the AlPO needles.

Analysis of the fluorescence of the crystals indicates that the fluorescence is not homogeneous along the particles but is concentrated in the center of the crystals and decreases towards the ends. This result suggests that the dye molecules are preferentially incorporated during the early stages of crystallization and as the concentration of the dye is reduced in the synthesis medium, the dye incorporation in the crystals is gradually decreased. This has been previously observed for a related system [2] and indicates a certain competition between the structure directing agent and the dye molecules.

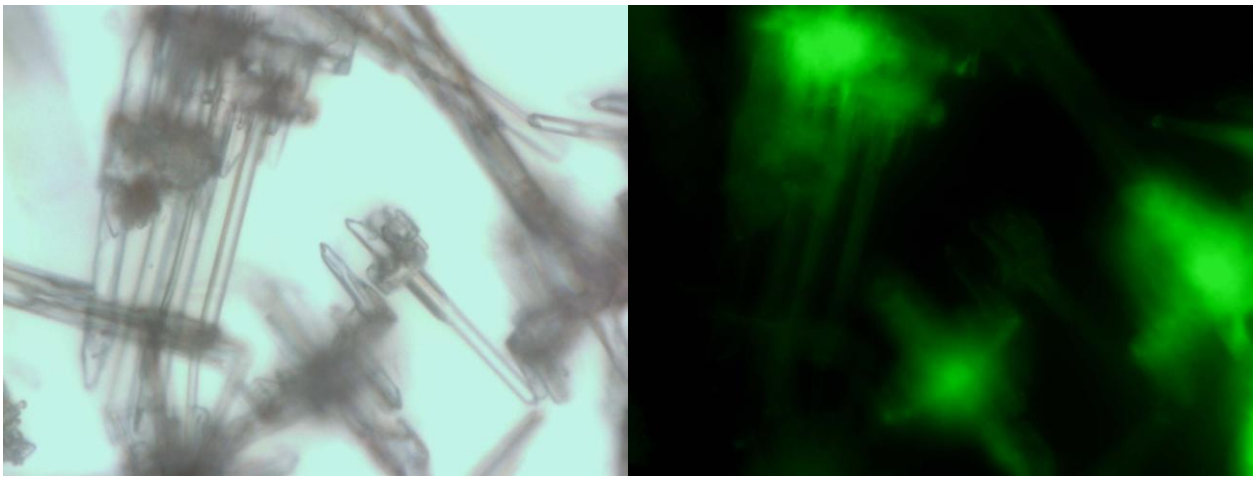


Figure 2. Fluorescence images of MgAPO-5 with PY included..

References

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