# Isomorphous substitution induced ionothermal synthesis of magnesium aluminophosphate zeolite in fluoride-free media

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## Supplementary Information

## Characterizations

Chemical composition analysis was determined with a Philips Magix X-ray fluorescence spectrometer. Powder X-ray diffraction (XRD) analysis of the as-synthesized samples are recorded on a PANalytical X´Pert PRO diffractometer fitted with Cu Kα radiation (λ = 1.5418 Å) operating at 40 mA and 40 kV. The Scanning electron microscopy (SEM) was performed on a Hitachi S4800 field-emission scanning electron microscopes. $^{31}P$ and $^{27}Al$ magic angle spinning (MAS) and $^{13}C$ cross polarization-magic angle spinning (CP-MAS) nuclear magnetic resonance (NMR) measurements were analyzed on a Varian Infinityplus-400 spectrometer. The acidity of the sample was characterized by using ammonia temperature programmed desorption ($NH_3$-TPD) with a Micromeritics Autochem 2910 automated catalyst characterization system. Thermal gravimetric/Differential scanning calorimetry (TG/DSC) was carried out under air atmosphere, using a NETZSCH STA 409PC thermoanalyser from room-temperature to 800 °C. The sample weight was 15 mg, and the heating rate was 10 °C/min, with an air flow rate of 30 ml/min.

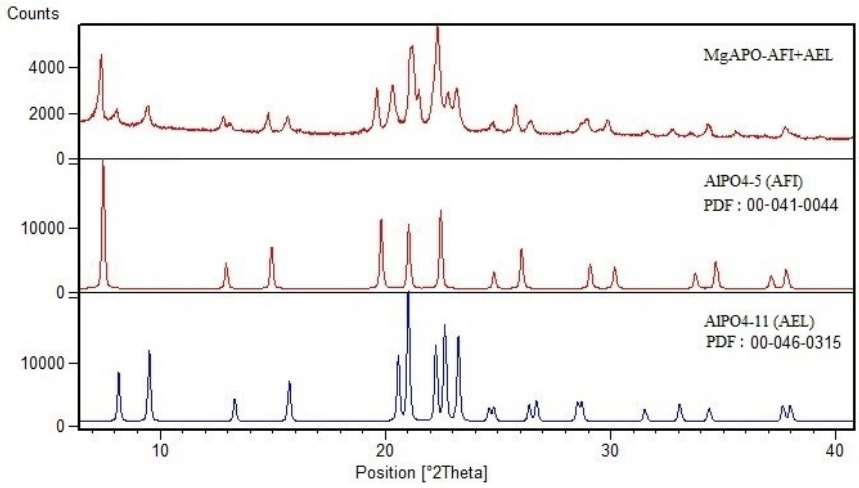


**Figure S1**. XRD pattern of MgAPOs with AFI and AEL structures and the reference XRD patterns of $AlPO_4$-11(AEL) and $AlPO_4$-5 (AFI).

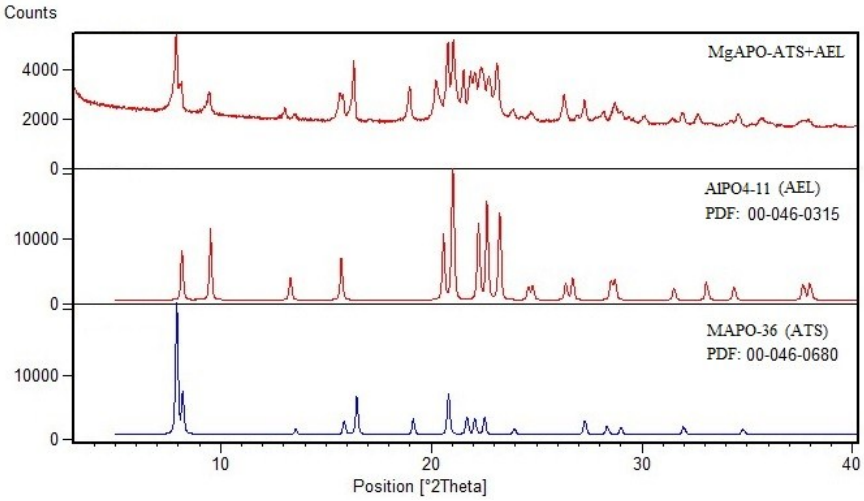


**Figure S2**. XRD pattern of MgAPOs with ATS and AEL structures and the reference XRD patterns of $AlPO_4$-11(AEL) and MAPO-36 (ATS).

**Table S1** Product structure and the $MgO/Al_2O_3$ ratio for the samples synthesized with different magnesium content in the initial mixture. Initial mixture composition (molar ratio): 1 $Al_2O_3$ : 3 $P_2O_5$ : x MgO : 80BMIMBrs, crystallization temperature : 200°C, crystallization time: 1 day.

| Sample | x | Structure | $MgO/Al_2O_3$ in the products* |
|---|---|---|---|
| A | 0.1 | AEL | 0.042 |
| B | 0.2 | AFI+AEL | 0.071 |
| C | 0.3 | AFI+AEL | 0.094 |
| D | 0.4 | AFI+AEL | 0.108 |
| E | 0.5 | AFI+AEL | 0.141 |

* Determined by X-ray fluorescence spectrometer element analysis.

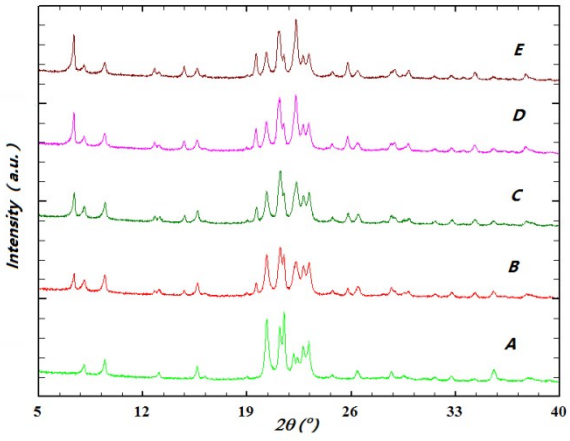


**Figure S3.** XRD patterns of the samples A-E synthesized with different magnesium concentration in the initial mixture.

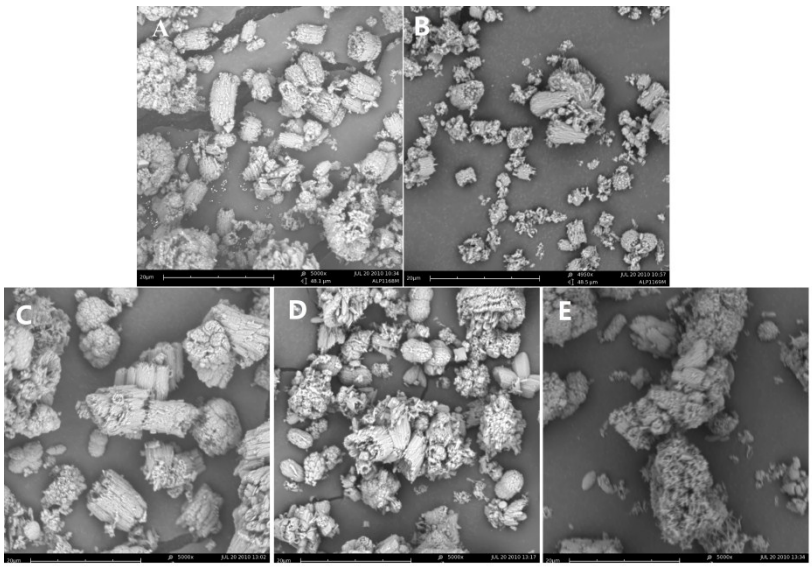


**Figure S4.** SEM images of the samples A-E synthesized with different magnesium concentration in the initial mixture.

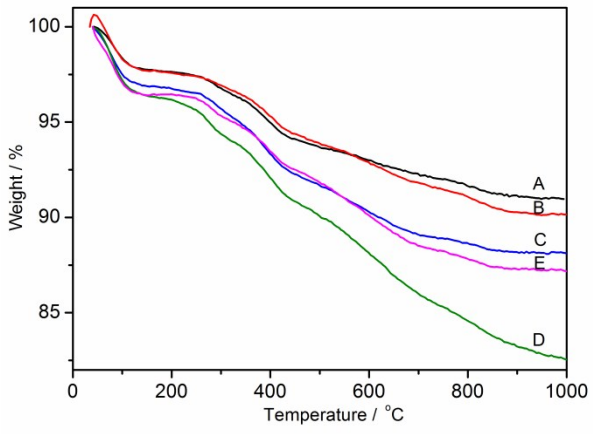


**Figure S5.** TG profiles of the samples A-E synthesized with different magnesium concentration in the initial mixture. Note: The weight loss increase with the magnesium content in the framework, for sample E possibly some extra-framework magnesium exists.