Tuning photoluminescence of Ag-doped 13X zeolites: Impact of synthesis strategy on luminescence enhancement and stability

Anna Safonova[1], Michele Cassetta[1,2], Gino Mariotto[1], Nicola Daldosso[1], Guilherme C. Concas[3], Tommaso del Rosso[3], Janna Attari[4], Farid Akhtar[4], Francesco Enrichi[1]

[1] *University of Verona, Italy*
[2] *University of Turin, Italy*
[3] *Pontifical Catholic University of Rio de Janeiro, Brazil*
[4] *Luleå University of Technology, Sweden*

anna.safonova@univr.it

This work presents a comparative study on the photoluminescent properties of Ag-doped 13X zeolites synthesized using two different methods. We demonstrate that through a simple and cost-effective ion-exchange process in water, it is possible to achieve strong and broadband PL emission. Our results reveal an excitation band centered at 313 nm across all studied Ag concentrations, with PL emission peaking at 568 nm. An increase in Ag concentration typically leads to concentration quenching effects, with a pronounced decrease in PL intensity at higher concentrations [1]. Notably, the new method of preparation effectively mitigates these quenching effects, achieving higher PL intensities at increased Ag concentrations compared to the previous method. Furthermore, we observe significant differences in PL decay times between the two methods, with the new method demonstrating longer lifetimes and reduced quenching at higher Ag loadings (up to 5 wt%). This improvement is attributed to the enhanced distribution and stabilization of Ag-related luminescent centers. Additionally, a distinct emission band in the 400–450 nm range is observed under specific excitation wavelengths only in the new method, suggesting the presence of additional emissive species, such as small Ag clusters. Overall, this study highlights how synthetic strategy critically influences the luminescence efficiency and stability of metal-doped zeolites, offering valuable insights for their development in optical sensing and imaging applications.

References

[1] H. Kawamoto, Y. Fujimoto, K. Asai, Radiation Physics and Chemistry, Vol. 234 (2025) 112769. DOI: 10.1016/j.radphyschem.2025.112769

Figures

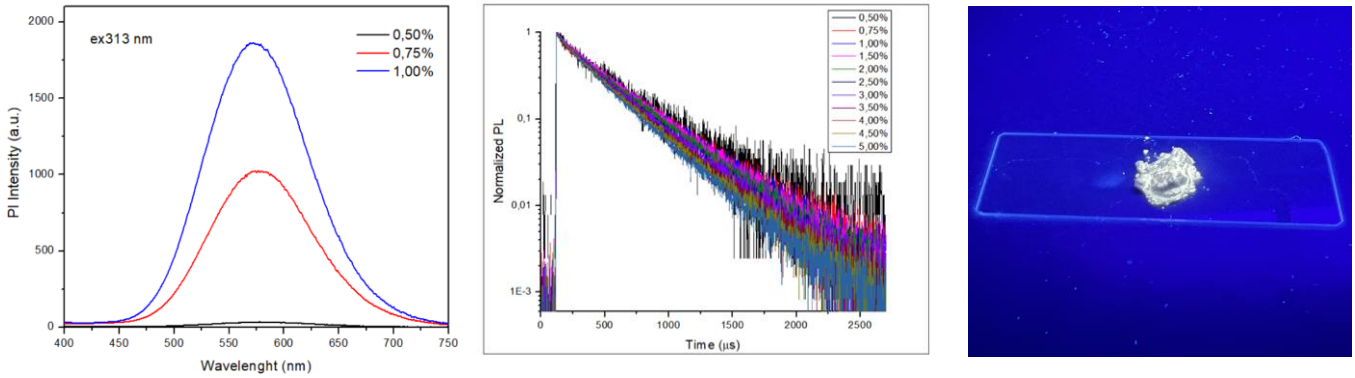

Figure 1: (a) PL emission of Ag-doped 13X zeolite; (b) Normalized photoluminescence (PL) decay curves of Ag-doped 13X zeolite samples with different Ag loadings (0.5–5.0 wt%) recorded under 313 nm excitation; (c) UV excited Ag-doped 13X powder.