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Surface modification of natural zeolite via Radio Frequency plasma treatment and coating with polyacrylic acid for controlled drug delivery

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This study focused on on the plasma surface modification of natural zeolite and coating with polyacrylic acid (PAA) for more efficient drug delivery. Zeolite, a mesoporous crystalline material, has shown great potential in this application due to its ion-exchange properties and porous structure [1]. However, further research on surface modification is essential to enhance the adsorption capacity of zeolite and its capability for drug release for more effective drug delivery. In this research, plasma-treated zeolites were used as a drug vehicle for diclofenac. It was then coated with PAA to facilitate a more controlled release over extended durations. Sodium-exchanged natural zeolite samples were exposed to 13.56 MHz radio frequency-driven plasma discharge, with Argon as the working gas. Drug-loaded samples were coated with PAA using a two-step method. An *in vitro* release test was performed to monitor the drug release mechanism of surface-modified zeolites in PBS (pH 7.4) for 120 hours.

Results showed that plasma-treated samples have a smaller particle size, greater surface area and porosity, and exhibited greater adsorption capacity as suggested by the greater % drug removal on diclofenac solutions. Na II and Si III species were sputtered off during plasma treatment of zeolite. The ablative effects reduced the size of zeolite particles, exposing more adsorption sites for drug loading.

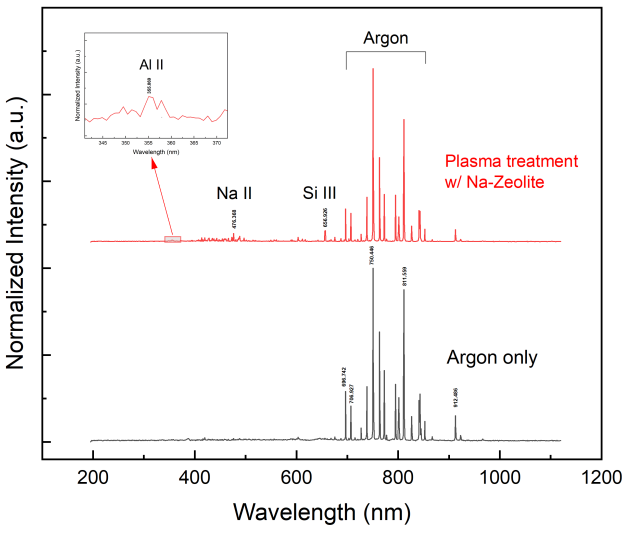

Figure 1. OES spectra of Argon plasma and Argon with the presence of Zeolite.

Both the plasma treatment and polymer coating did not alter the bulk properties of zeolite samples, as indicated by the XRD spectra of untreated and surface-modified samples. For the *in vitro* release test, the polymer-coated samples released relatively smaller concentrations during the entire duration of immersion with PBS as compared to uncoated samples. The plasma treatment and polymer coating were effective methods in modifying the surface properties of natural zeolite, thereby increasing its potential for drug delivery applications.

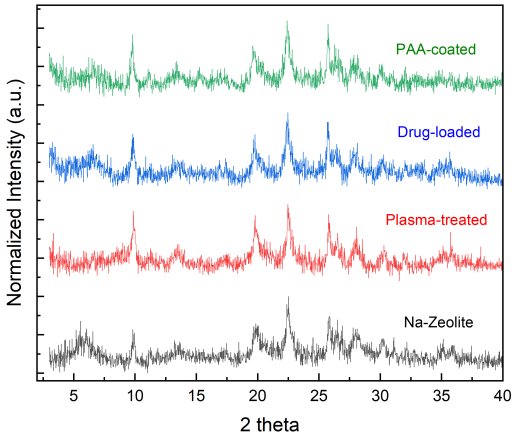

Figure 2. XRD spectra of zeolite samples

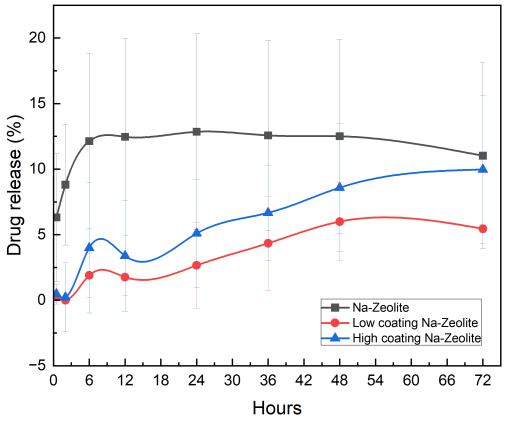

Figure 3. Drug release profiles of zeolite samples

References

[1] Servatan, M., Zarrintaj, P., Mahmodi, G., Kim, S. J., Ganjali, M. R., Saeb, M. R., & Mozafari, M. (2020). Zeolites in drug delivery: Progress, challenges and opportunities. *Drug Discovery Today*, *25*(4), 642-656.