Electronic Supplementary Information

Nanoporous Photonic Crystals with Tailored Surface Chemistry for Ionic Copper Sensing

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Figure S1. Dynamic flow cell system used to quantify spectral shifts in PEI-GA-PEI-functionalized NAA-GIFs. Reflection spectra were measured using miniature optical fiber spectrophotometers combined with a transparent flow cell based on acrylic plastic to create a microfluidics continuous flow system. The system is composed of a bifurcated optical probe, in which one of the arms carries white light from the tungsten source (LS-1LL, Ocean optics, USA). The optical probe illuminates white light onto the sensing platform over a spot size of ~2 mm in diameter. Subsequently, the reflected light is collected by the other arm (i.e. collection fiber integrated into the same optical probe), which is guided to the miniature spectrophotometer for real-time monitoring and quantification.

Figure S2. Top view FEG-SEM images of representative NAA-GIFs before (a) and after (b) functionalization with PEI-GA-PEI functional layers (scale bars = 500 nm) (NB: NAA-GIFs fabricated with $T_p = 600 \text{ s}$).
Figure S3. Reflection spectra of NAA-GIFs produced by SPA with varying anodization period, showing the tuneability and resolution of the characteristic photonic stopband (PBS) across the spectral regions, from visible to NIR: a) $T_P = 500$ s, b) $T_P = 600$ s, c) $T_P = 700$ s, and d) $T_P = 1500$ s (NB: $FWHM_{PSB} = 3.87 \pm 0.02, 4.74 \pm 0.02, 5.46 \pm 0.02$ and $105.54 \pm 1.04$ nm for NAA-GIFs produced with $T_P = 500, 600, 700$ and $1500$ s, respectively).
Figure S4. Real-time monitoring of copper ions binding as a function of [Cu²⁺], from 1 to 100 mM, using $\Delta \lambda_{PSB}$ as sensing parameter in PEI-GA-PEI-functionalized NAA-GIFs produced with: a) $T_p = 500$ s, b) $T_p = 600$ s, c) $T_p = 700$ s, and d) $T_p = 1500$ s.
Figure S5. Langmuir and Freundlich isotherm models and experimental data describing the binding mechanism of copper ions by PEI-GA-PEI-functionalized NAA-GIFs produced with: a) $T_p = 500$ s, b) $T_p = 600$ s, c) $T_p = 700$ s, and d) $T_p = 1500$ s.