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A novel nanostructure for ultrasensitive volatile organic compound sensing[1] HUAIZHOU ZHAO, BINOD RIZAL, ZHIFENG REN, MICHAEL J. NAUGHTON, THOMAS C. CHILES, DONG CAI, Boston College — We have developed an arrayed nanocoaxial structure for the ultrasensitive sensing detection and identification of volatile organic compounds (VOC) by dielectric impedance spectroscopy. VOC molecules are absorbed into porous dielectric material in the annulus between nanoscale coax electrodes. A theoretical expression for the basic adsorption mechanism agrees with the experimental results. Detection sensitivities at parts-per-billion levels were demonstrated for a variety of VOCs. A limit-of-detection of ethanol reached ∼100 parts-per-trillion, following a Freundlich power-law isotherm across four decades of ethanol concentration. A linear dependence on VOC dielectric constant was observed. Dielectric impedance nanospectroscopy was also performed by scanning frequency from 10 mHz to 1 MHz, with distinctive spectra of different VOCs discovered. These were utilized to conduct colorimetric identification of VOCs. The results suggest our novel nanocoaxial sensor can be used as a sensitive, broadband, and multimodal sensing platform for chemical detection.

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