Supporting Information

In Situ Localized Growth of Ordered Metal Oxide Hollow Sphere Array on Microheater Platform for Sensitive, Ultra-Fast Gas Sensing

Ameya Rao\textsuperscript{1,2,‡}, Hu Long\textsuperscript{1,2,3,‡}, Anna Harley-Trochimczyk\textsuperscript{1,2}, Thang Pham\textsuperscript{4,5,6,7}, Alex Zettl\textsuperscript{5,6,7}, Carlo Carraro\textsuperscript{1,2}, Roya Maboudian\textsuperscript{1,2,*}

\textsuperscript{1}Department of Chemical and Biomolecular Engineering, University of California, Berkeley, CA 94720, USA
\textsuperscript{2}Berkeley Sensor & Actuator Center, University of California, Berkeley, CA 94720, USA
\textsuperscript{3}State Key Laboratory of Digital Manufacturing Equipment and Technology, Huazhong University of Science and Technology, Wuhan 430074, China
\textsuperscript{4}Department of Materials Science and Engineering, University of California, Berkeley, CA 94720, USA
\textsuperscript{5}Department of Physics, University of California, Berkeley, CA 94720, USA
\textsuperscript{6}Materials Science Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA
\textsuperscript{7}Kavli Energy NanoSciences Institute at the University of California, Berkeley and the Lawrence Berkeley National Laboratory, Berkeley, CA 94720

*Corresponding author. Email: maboudia@berkeley.edu

\textsuperscript{‡}Ameya Rao and Hu Long contributed equally.
Figure S1. Microheater power consumption versus operating temperature.

Figure S2. Water contact angle of the microheater chip (a) before and (b) after surface modification with FDTS SAM.
Figure S3. FESEM images of the large-area deposition of the PS sphere array. Scale bars: (a) 20 μm, (b) 10 μm.
Figure S4. FESEM images of grown hollow sphere nanostructures: (a,b) In$_2$O$_3$, (c,d) NiO, and (e,f) double-shell SnO$_2$ (inner shell) / In$_2$O$_3$ (outer shell).
Figure S5. Survey XPS spectrum of the single-shell SnO$_2$ hollow sphere array.

(Note: the SnO$_2$ hollow sphere array was synthesized on a Si substrate with interdigitated Au (100 nm) electrodes for XPS characterization.)
**Figure S6.** XPS spectra of the double-shell SnO$_2$ (inner shell) / In$_2$O$_3$ (outer shell) hollow sphere array (FESEM images shown in Figure S4e,f): (a) survey spectrum, (b) Sn 3d, (c) In 3d, and (d) O 1s regions.

(Note: the double-shell SnO$_2$ / In$_2$O$_3$ hollow sphere array was synthesized on a Au (100 nm)-coated Si substrate for XPS characterization.)