Electronic Supplementary Material (ESI) for Lab on a Chip.

Supporting Information

All-soft, battery-free, and wireless chemical sensing platform based on liquid metal for liquid- and gas-phase VOC detection

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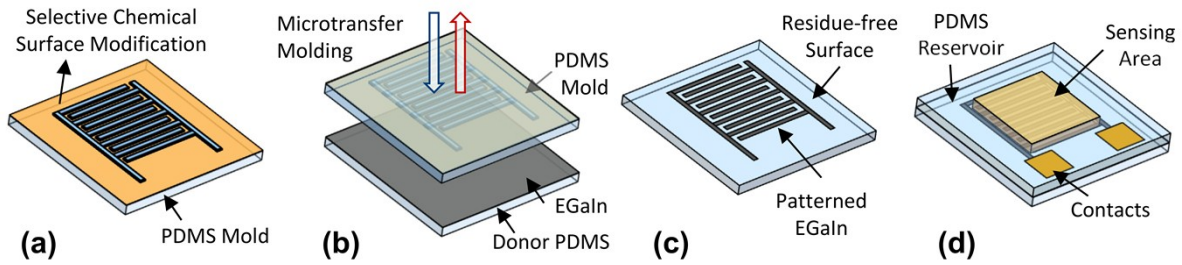

Fig. S1 An advanced EGaIn patterning process for scalable, uniform, and residue-free EGaIn thin-line fabrication: (a) selective chemical surface modification of the PDMS mold, (b) microtransfer molding of EGaIn, (c) EGaIn-filled PDMS mold after residue transfer, and (d) microfluidic integration and vertical interconnection.[29,30]

Advanced EGaIn thin-line patterning process[29,30]: The surface of the PDMS mold for the interdigitated capacitor is selectively chemically modified using toluene for selective wetting. Then, the PDMS mold is pressed onto a donor substrate coated with the liquid metal film and separated from it. Liquid metal residue on the outside of the channels can now be effectively transferred to a sacrificial PDMS layer. Finally, the patterned capacitor is covered with a PDMS microfluidic reservoir for liquid-phase and gas-phase VOC detection.

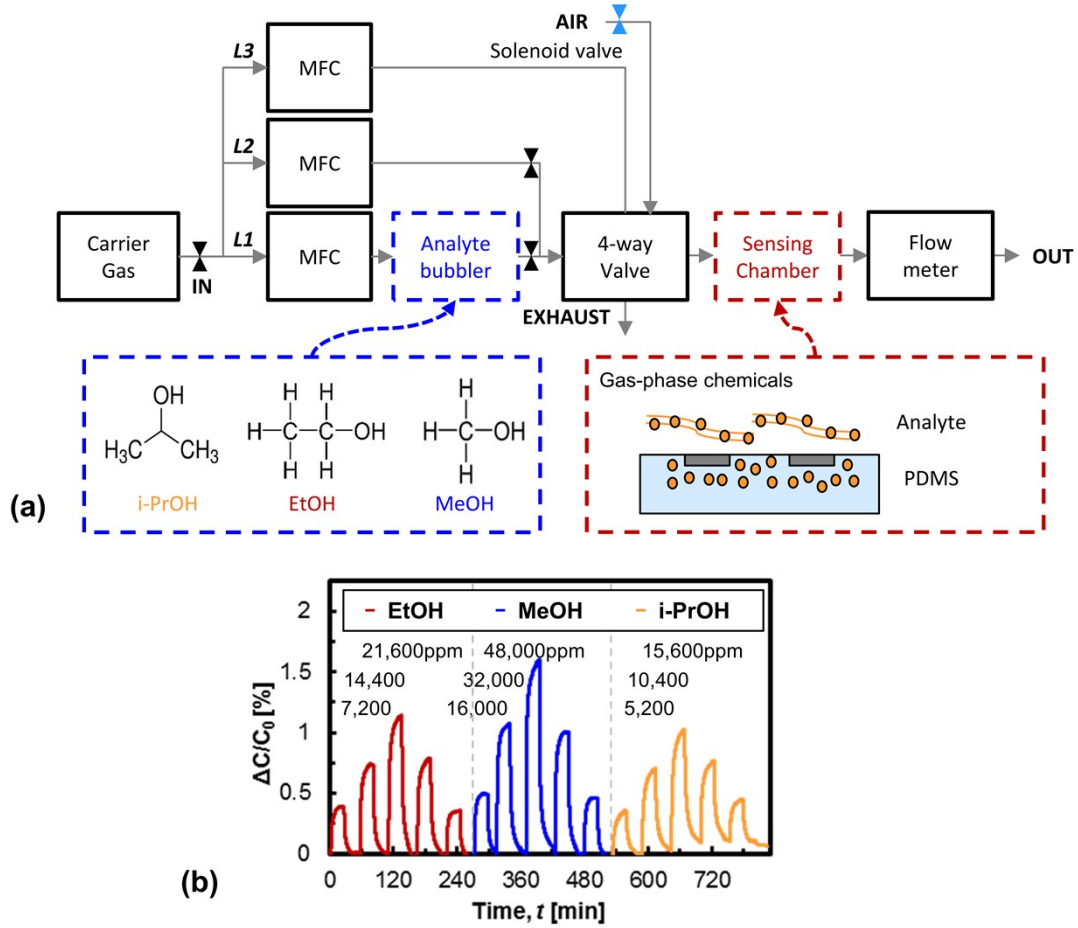

Fig. S2 (a) Schematic of gas testing setup with mass-flow-controlled (MFC) analyte (*L1*), diluting (*L2*), and reference (*L3*) lines to generate different analyte concentrations and rapidly switch between analyte and reference gas streams using a 4-way valve; (b) Measured relative capacitance changes while subsequently exposing the sensor to different analyte concentrations of ethanol (EtOH), methanol (MeOH), and isopropanol (i-PrOH) with reference gas purging steps inbetween each analyte exposure.

Measurement. A custom-made gas mixing system is used for VOC gas sensing at different analyte concentrations. The incoming carrier gas is split into three gas streams (*L*1 - *L*3). A gas stream loaded with the desired VOC at its (temperature-dependent) saturated vapor pressure is generated by feeding carrier gas through a temperature-controlled bubbler containing analyte-soaked quartz sand (*L1*). The VOC gas stream is diluted by a secondary carrier gas stream (*L2*) before flowing across the sensor mounted in the measurement chamber. After each analyte exposure, the reference stream (*L3*) flushes the sensing chamber with a reference gas. Rapid switching between analyte and reference gas streams is achieved using a 4-way valve. Each gas stream is individually controlled and monitored by a mass flow controller (MFC). The measurements were carried out at room temperature and near zero RH.

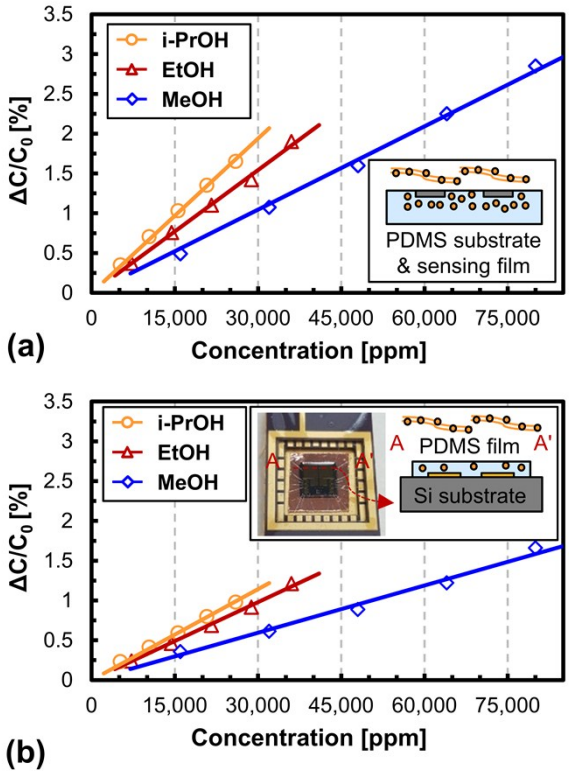

Fig. S3 Measured relative capacitance changes of (a) all-soft sensor and (b) solid-state sensor with a PDMS sensing film as a function of the analyte concentrations of isopropanol (i-PrOH), ethanol (EtOH), and methanol (MeOH).

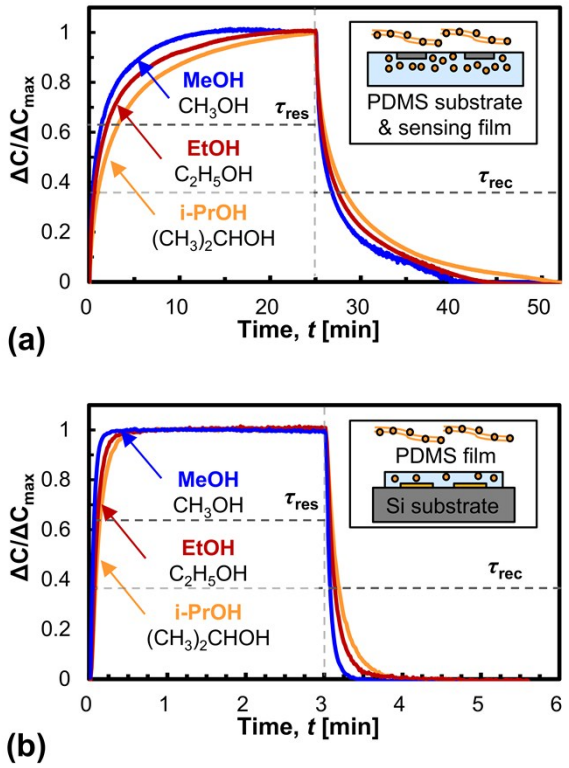

Fig. S4 Transient signal responses, i.e. normalized capacitance changes, during analyte absorption and subsequent analyte desorption for (a) all-soft sensor (b) solid-state sensor with a PDMS sensing film upon exposure to isopropanol (i-PrOH), ethanol (EtOH), and methanol (MeOH).