Rational design strategies for oxide chemiresistors with rapid sensing kinetics, high selectivity, and sensitivity

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Oxide chemiresistors have attracted remarkable attention for diverse applications, including indoor air quality monitoring, food freshness assessment, and human breath analysis. However, their inherently simple sensing mechanism often limits the selective and sensitive detection of weakly reactive airborne chemicals. In addition, some gas-sensing reactions are partially irreversible and exhibit sluggish response and recovery kinetics, hindering reliable analyte detection. Herein, rational design strategies are proposed to simultaneously enhance gas selectivity, sensitivity, and response kinetics. Furthermore, sensor arrays incorporating selective sensing elements enable discriminative quantification of various analytes, even under mixed-gas conditions. The key approaches underlying these advances include the implementation of bilayer architectures, microreactive catalysts, and gas-on-demand heterogeneous catalytic systems to boost selectivity and reactivity, as well as the construction of highly porous structures that promote facile surface redox reactions on the oxide chemiresistor surface.