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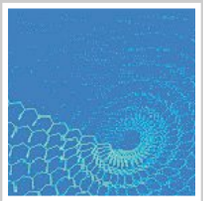

Polymer and Colloid Highlights

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Interaction of Rare-earth-based Nanoparticles with Carbon Dioxide

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Increasing carbon dioxide production has become a challenge for our society. Nowadays, scientists and engineers are intensifying efforts to develop solutions to mitigate climate change. The strategies can entail many things, for example developing new materials for capture, transport, storage, but also for an efficient conversion of CO_2 to useful chemicals. Carbon dioxide detection is an indispensable part of any of these approaches, but the operating conditions can be extremely different.

Today, CO_2-sensing is still performed with infrared spectroscopy owing to trade-offs between the technological and economical factors and having limited, or no portability. Chemo-resistive sensing is an attractive alternative. However, among different inorganic materials only rare-earth-based sensors, particularly lanthanum oxycarbonate-based, show significant resistance changes upon exposure to CO_2 at elevated temperatures (Fig. 1A). To reveal the uniqueness of $La_2O_2CO_3$ particles, we studied their atomic and electronic structure by means of X-ray diffraction, high-energy resolution fluorescence detected X-ray absorption (HERFD XAS) and valence-to-core X-ray emission spectroscopy (vtc-XES). The *in situ* studies show that upon interaction with relatively inert CO_2 the distribution of unoccupied lanthanum d-states and occupied O p- and La d-states change significantly (Fig. 1B).[1] Nevertheless, the realization of a low-power, room temperature chemo-resistive-sensor cannot be achieved based solely on $La_2O_2CO_3$. Thus, we utilize poly [(p-vinylbenzyl) trimethylammonium hexafluorophosphate], P[VBTMA][PF_6], as a matrix for $La_2O_2CO_3$ (Fig. 2A). We are taking advantage of the interaction at the organic/inorganic interface to boost the overall conductivity of composites at room temperature (Fig. 2B), which brings realization of chemo-resistive CO_2 sensing within reach.[2]

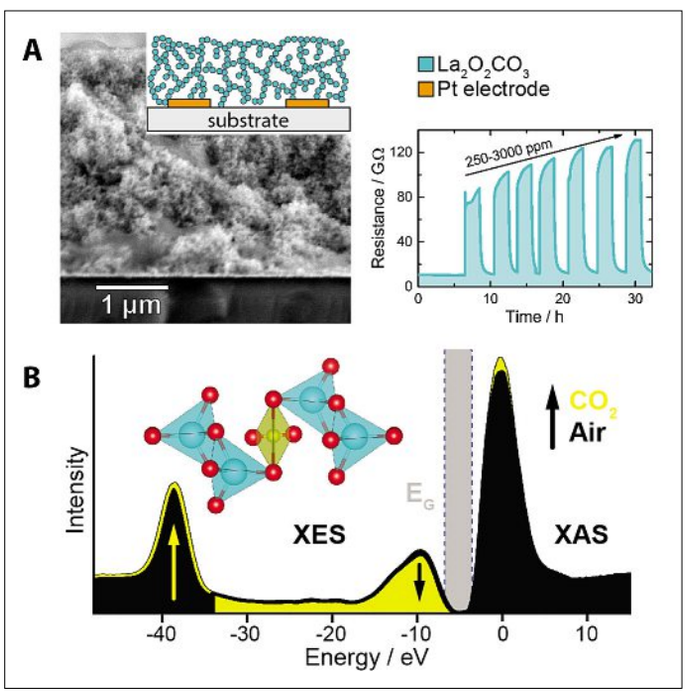

Fig. 1. A: SEM image and scheme of $La_2O_2CO_3$-film and DC resistance changes during exposure to CO_2 pulses. B: *in situ* HERFD-XAS and vtc-XES spectra changes upon exposure to 1% CO_2 at 250 °C.

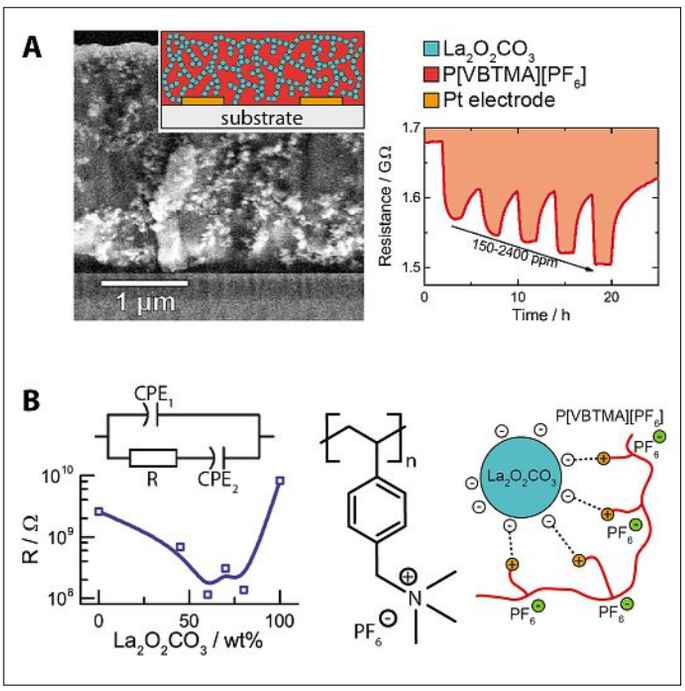

Fig. 2. A: SEM image and scheme of composite film, DC resistance changes during exposure to CO_2 pulses at RT. B: Model circuit of composite film with evolution of baseline resistance as a function of inorganic particle content (left). Model of P[VBTMA][PF_6]/$La_2O_2CO_3$ interface (right).

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[2] C. Willa, J. Yuan, M. Niederberger, D. Koziej, *Adv. Funct. Mater.* 2015, *25*, 2537.

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