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Electronic Supplementary Information

A New Kind of Thermocouple Made of *p*-Type and *n*-Type Semi-Conductive Oxides with Giant Thermoelectric Voltage for High Temperature Sensing

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The schematic diagram of screen-printing thermocouple is shown in Fig. S1. Firstly, the powder of material *A* synthesized by sol-gel method is put into a beaker. Then, the binder is added in the breaker under stirring to form the screen-printing paste. After that, the prepared paste is loaded on the top of the screen with a *L*-form pattern. Through the movement of wiper, one electrode composed of material *A* is screen-printed on the surface of Al_2O_3 substrate and then heated on the heating stage at 110 °C for 10 minutes. Secondly, another electrode of thermocouple is fabricated by the same steps with the powder of material *B*. Finally, the copper wires are attached onto the end of electrodes by silver paste and then heated at 200 °C for 2 hrs in a furnace.

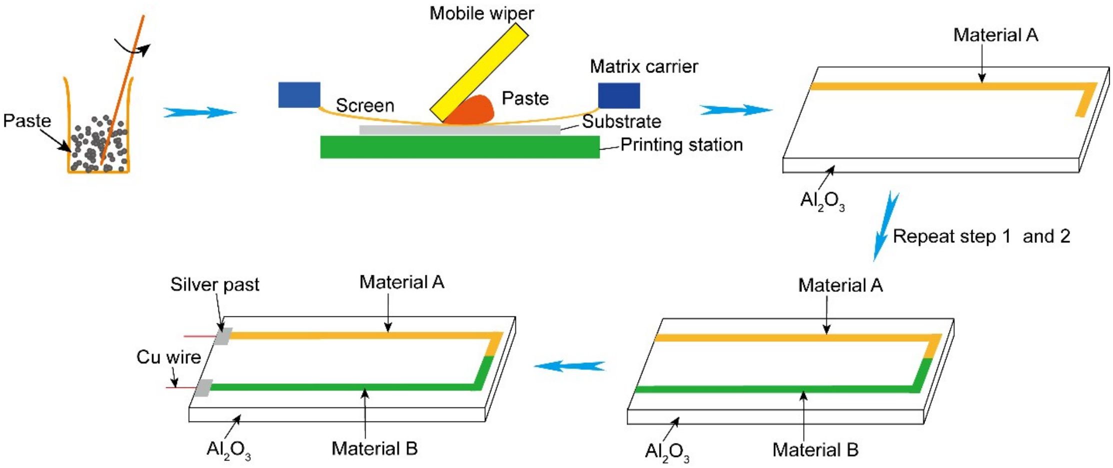

Fig. S1. Schematic diagram of screen-printing thermocouple.

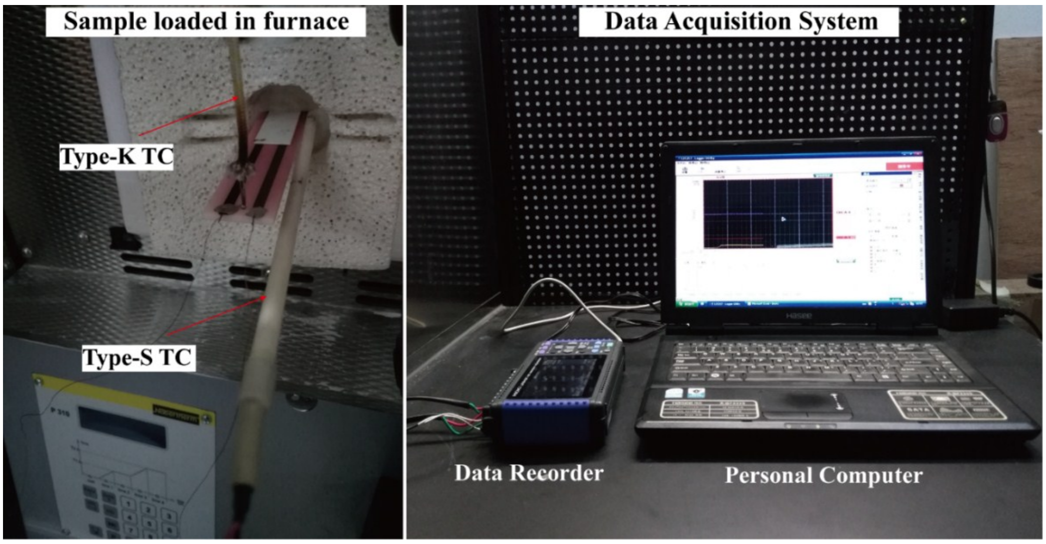

Fig. S2. Photograph of the test bed used for high-temperature thermoelectric measurement.

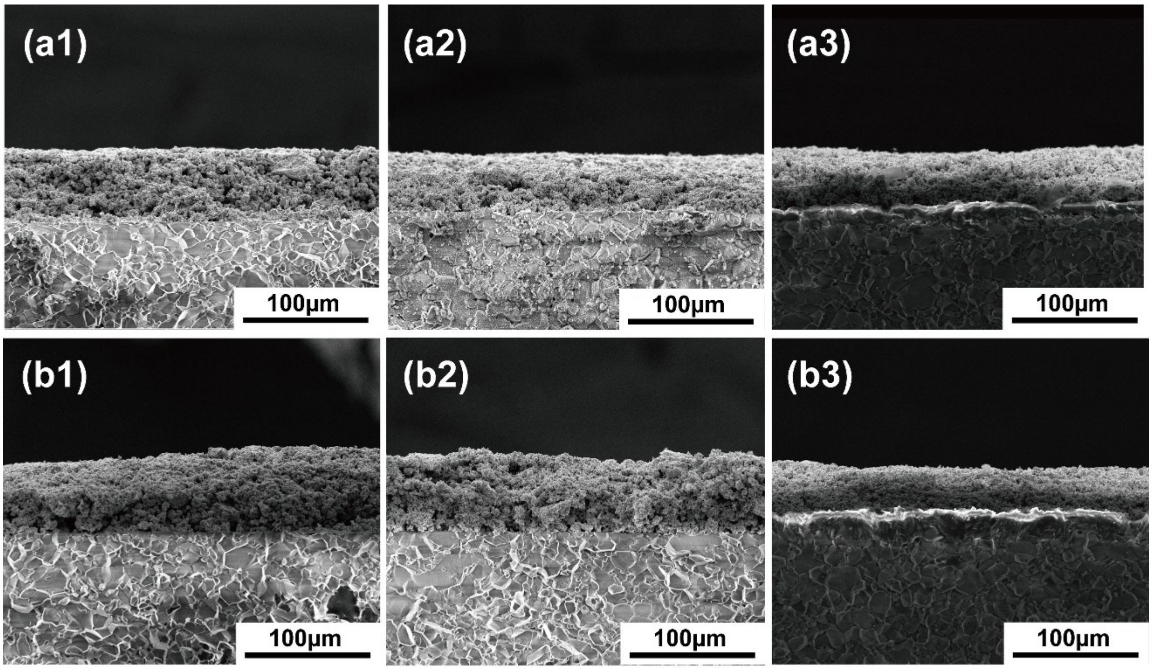

Fig. S3. SEM pictures of cross sections of In_2O_3, ITO and 0.2LSCO. Figures **A**(1-3) represent the cross sections of In_2O_3, ITO and 0.2LSCO treated at 1270 ^oC for 2hrs, respectively. Figures **B**(1-3) represent the cross sections of In_2O_3, ITO and 0.2LSCO treated at 1270 ^oC for 12 hrs, respectively.

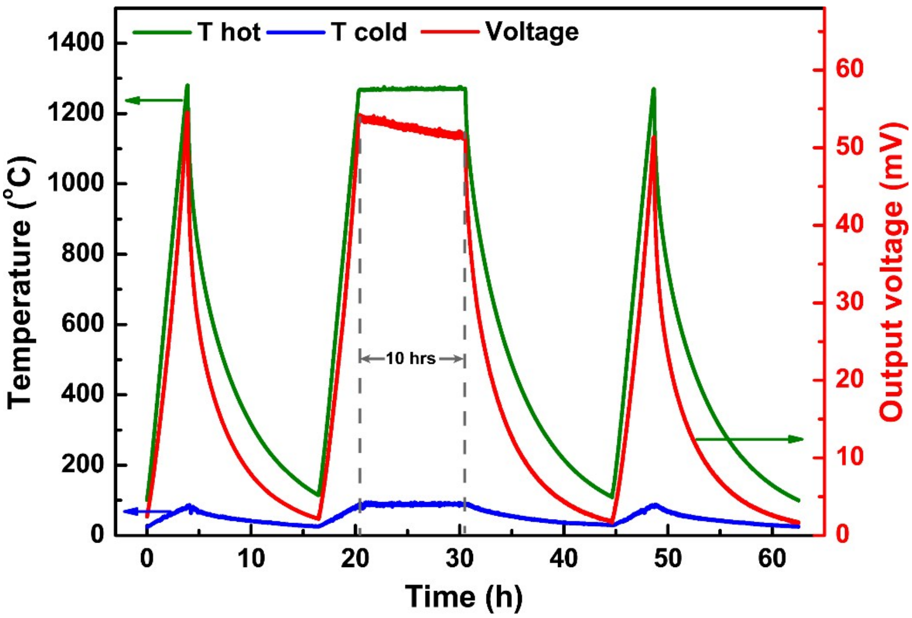

Fig. S4. Thermoelectric response of the ITO *vs.* In_2O_3 thermocouple. The red curve represents the thermoelectric voltage corresponding to the secondary y-axis. The olive and the blue curves are the hot junction (T hot) and cold junction (T cold) temperatures, respectively, corresponding to the primary y-axis.

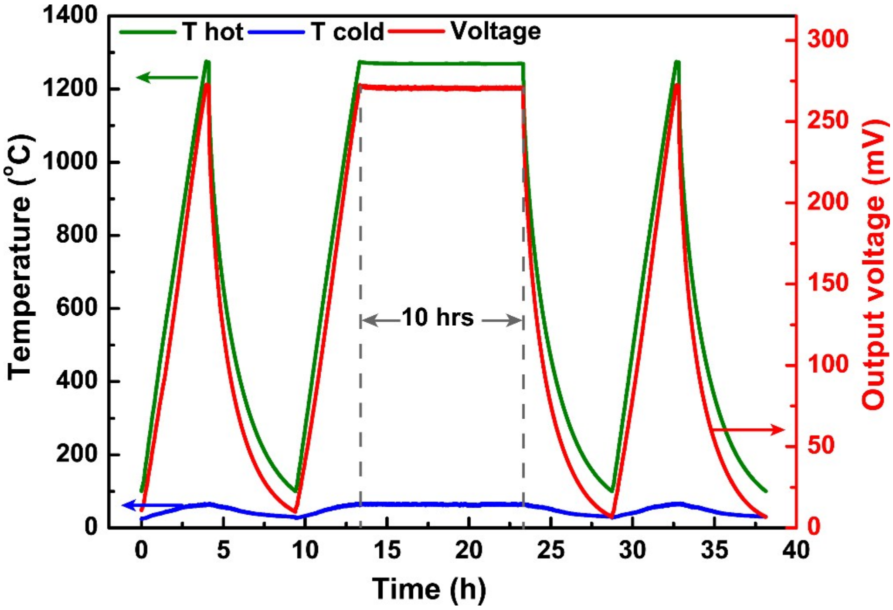

Fig. S5. Thermoelectric response of 0.2LSCO *vs.* ITO thermocouple. The red curve represents the thermoelectric voltage corresponding to the secondary y-axis. The olive and the blue curves are the hot junction (T hot) and cold junction (T cold) temperatures, respectively, corresponding to the primary y-axis.

Fig. S6 shows the output voltage variations of ITO *vs.* In_2O_3, 0.2LSCO *vs.* ITO and 0.2LSCO *vs.* In_2O_3 thick-film thermocouples soaked at 1270 °C for 10 hrs, respectively. The magenta dash lines represent their own mean values in the picture. For 0.2LSCO *vs.* ITO and 0.2LSCO *vs.* In_2O_3, there are very small voltage variation around their mean value when the temperature of the heating furnace reach the dynamic balance at about 1270 °C compared with standard commercial thermocouple Type-*S*, indicating they have a very high thermal stability. The mean values of them are derived from calculating the output voltages of 2 hrs to 10 hrs. While for ITO *vs.* In_2O_3, the output voltage reduces continuously to form an obvious deviation from its mean value, indicating it is unstable to suffer from high temperature for a long time.

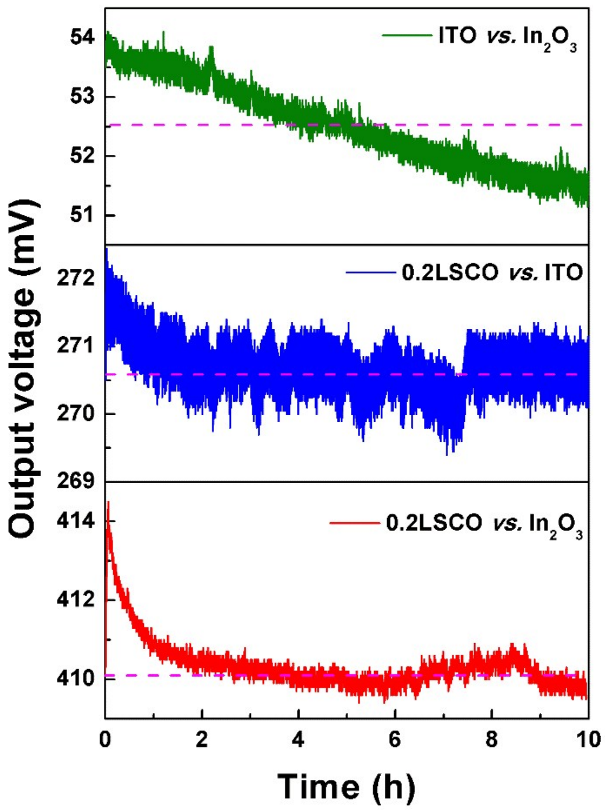

Fig. S6. The output voltage variations of ITO *vs.* In_2O_3, 0.2LSCO *vs.* ITO and 0.2LSCO *vs.* In_2O_3 thick-film thermocouples soaked at 1270 ^{o}C for 10 hrs, respectively.

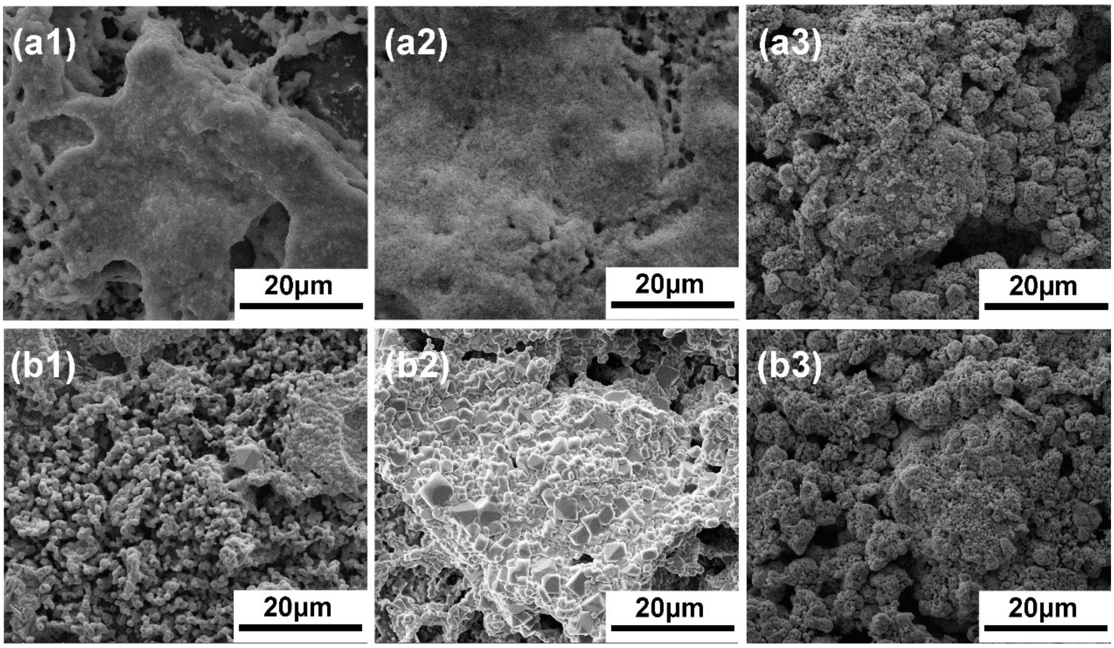

Fig. S7. SEM pictures of the surface of In_2O_3, ITO and 0.2LSCO. Figures A(1-3) represent the surface of In_2O_3, ITO and 0.2LSCO treated at 1270 °C for 2 hrs, respectively. Figures B(1-3) represent the surface of In_2O_3, ITO and 0.2LSCO treated at 1270 °C for 12 hrs, respectively.