Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supplementary Information for
Tuning Thermal and Electrical Properties of MXenes *via* Dehydration

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S1. MXene-based Sensors: Validation, and Durability

To assess their performance and further evaluate their durability, the MXene-based sensors were produced and kept for three months under dry conditions. The samples were then placed in a controlled humidity chamber and the real-time RH was also recorded. Despite being exposed to air and the risk to undergo oxidation processes, the RH response of the fabricated humidity sensor remained stable, as shown in **Figure S1b,c.** In particular, a linear decrease in the RH was observed as the electrical conductivity increased (**Figure S1b**). One possible explanation is that fewer water molecules were captured between the MXene flakes, which reduced the water-surface contact distance and the surface and attracted the water molecules onto the surface, increasing the overall electrical conductivity measured according to Kirchhoff's law. On the other hand, the RH increased with increasing thermal diffusivity. Moreover, the electrical conductivity of the sensor was rather sensitive in the range of 4.02 to $4.32 \cdot 10^3$ S m^{-1}, corresponding to relative humidity values from 50% to 30%. The narrow range of the measured electrical conductivities suggests that any small change in electrical properties could provide large and reliable relative humidity signals. The thermal diffusivities showed a positive linear relationship with the RH. A higher thermal diffusivity reflected a stronger RH signal, which could be attributed to the adsorbed water molecules onto the MXene surface, as shown in **Figure S1C**.

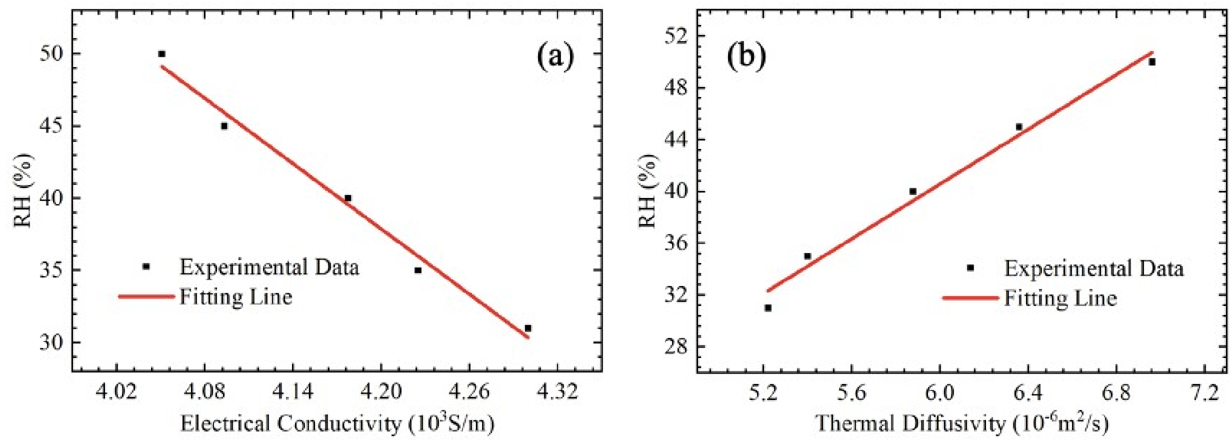

Figure S1. Plots of RH as a function of measured (a) electrical conductivity and (b) thermal diffusivity values. In general, higher electrical conductivity or lower thermal diffusivity values of the sample reflect a lower RH.

S1. The MXene sample in heating treatment at 65°C

Figure S2. The MXene sample in heating treatment at 65°C