Diverse electronic states of 2D electrides : From trapping to floating states

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Electride, which is regarded as a new emergent quantum material, is ionic crystal in which electrons serve as anions, trapping in the positively charged lattice framework. The physical properties of electrides are determined by the topology of cavities or channels which confine anionic electrons. Recently, it was demonstrated that the intralayer space of 2D layered materials can be the confining sites for anionic electrons, showing a freedom in degree of localization. This new 2-dimensional electrides have provided fundamental difference in electronic structure from the 2-dimensional electron gas systems in topology and physical properties. In this talk, the layered structured 2-dimensional electrides, from the first discovered dicalcium nitride to various transition metal carbides, chalcogenides and chlorides, will be introduced and highlighted with their diverse electronic states. From the different localization degree of anionic electrons in 2D interlayer space, various physical and chemical properties were emerged. In particular, as a highlighted physical property, the magnetism based on the anionic electrons will be discussed. We have systematically controlled the magnetic properties of 2-dimensional electrides from the discovery of rare-earth metal carbides, showing diverse magnetism such as superparamagnetism, antiferromagnetism, ferrimagnetism and ferromagnetism. Furthermore, it will be introduced that 2D ferromagnetism based on two-dimensionally confined anionic electrons may be possible in electrides without magnetic elements. Finally, the floating electrons on the surface will be highlighted as an emergent feature of 2D electrides.