

# Floating gate effect on two-dimensional electronics by tunneling-triboelectric charge

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## Abstract

Triboelectrification is the electrical charging by friction between two materials. Though the triboelectric effect is reported to have been first observed by Thales of Miletus, it is still a subject of intense research and, recently, has been investigated, with nanoscale spatial resolution, by using atomic force microscopy (AFM). In practice, by rubbing insulators with the tips of AFM1, electrical charges can be localized on insulators and be stored for relatively long periods, around one hour. Here we introduce tunneling triboelectrification for defining on demand rewritable ghost floating gates below a 2D material with the nanometer spatial resolution of AFM. Tunneling triboelectrification is the friction-induced tunneling of charges through a 2D material and their accurate localization on the insulator underneath the 2D material. Tunneling of charges may also occur in conventional triboelectrification processes, but in tunneling triboelectrification charges tunnel through a 2D material rather than simply through air or vacuum. Moreover, though charges can be localized even by conventional triboelectrification of dielectrics such as SiO<sub>2</sub>, the charges injected by tunneling triboelectrification exhibit impressively longer lifetimes (e.g. more than two order of magnitude longer). Finally, after tunneling triboelectrification, the charges very effectively control the properties of the 2D material, thus behaving as immaterial, charges-only, ghost floating gates which can be repeatedly created, modified or destroyed; this unique property may be the key for the development of novel 2D devices which can be drawn or modified on demand.

**Keywords:** triboelectric effect, floating gate, two-dimensional material, atomic force microscopy

## References

- [ 1 ] Rewritable ghost floating gates by tunnelling triboelectrification for two-dimensional electronics, Nature communications, 15891 (2017)

## Biography

Tae Yun Kim is visiting postdoctoral researcher at University of Cambridge. He received Ph.D. from Sungkyunkwan Advanced Institute of Nano Technology in Sungkyunkwan University. His research expertise are synthesis and chracterization of nano-material and development of electronic devices.