Probing electron behaviour at the tips of nanocones

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One of the ways of improving electrons manipulation is though better control over one of their inner characteristics, called spin. This approach is the object of an entire field of study, known as spintronics. Now, Richard Pincak from the Slovak Academy of Sciences and colleagues have just uncovered new possibilities for manipulating the electrons on the tips of graphitic nanocones. Indeed, in a study published in *EPJ B*, they have shown that because the tip area offers the greatest curvature, it gives rise, in the presence of defects, to an enhanced manifestation of a phenomenon called spin-orbit interaction. This, in turn, affects its electronic characteristics. These nanocones could thus become candidates for a new type of scanning probe in atomic force microscopy.

Spin-orbit interaction refers to the interaction of an electron's spin with its motion. Such spin-orbit interaction can, for example, cause shifts in an electron's atomic energy levels. This is due to electromagnetic interaction between the electron's spin and the magnetic field generated by the electron's orbit around the nucleus. In carbon, such interaction is expected to be weak because of its low atomic number. Yet, in a carbon nanocone, the spin-orbit interaction is different and thought to be induced by the curvature.

Pincak and colleagues found that the spin-orbit interaction considerably affects the local density of the nanocone's electron states. They also discovered that the extent of defects makes a difference. The more defects there are, the greater the curvature of the nanocone in the vicinity of the tip - and the greater the effect of the spin-orbit interaction

is. This in turn produces the highest impact on the cone's electronic properties. These findings provide a new potential for exploiting the spin-orbit interaction induced by curvature to manipulate electrons in spintronics applications.

More information: R. Pincak, J. Smotlacha, and M.Pudlak (2015), "Spin-orbit interaction in the graphitic nanocone," *European Physical Journal B*, DOI: 10.1140/epjb/e2014-50413-9