ANGLE DEPENDENCE OF THE MAGNETORESISTANCE IN Bi NANOWIRES

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Bulk bismuth has been classified as a trivial topological insulator (TI) where the surface states do not have topological protection. Still, the electronic mobility of surface states is exceptionally large. This is not surprising if we consider that bulk Bi can be assembled by stacking bilayers, and that the bilayer of Bi is thought to represent a two dimensional TI that supports edge modes propagating along the perimeter of the sample, modes that exhibit coherent propagation and suppression of backscattering [1].

Recently, it has even been proposed that the hinges of the surface of the crystal also have special topological properties, hosting topologically protected conducting modes. Experimental studies that probe the surface of bulk bismuth as a composite of edges on the surface of bulk Bi are lacking and we present angle-dependent transverse magnetoresistance (TMR) oscillation measurements of small diameter (50 nm) bismuth nanowires where electronic transport is dominated by the surface, rather than the bulk in the core of the nanowire, because of quantum confinement. We find that the TMR of the surface states in our nanowires exhibits a number of nanowire rotation angles that strongly suggest an interpretation in terms of Yamaji magic angles [2]. Magic angles are observed in layered and other low-dimensional conductors with weak interplanar coupling that are amenable to be described by an open, corrugated, Fermi surface [3]. In contrast to nanowires, bulk bismuth does not display magic angles since the Fermi surface is closed. The main Fermi surface parameters that we observe: Fermi wavevector, charge density, and interplanar coupling will be discussed.

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References

1. HUBER, T., JOHNSON, S., KONOPKO, L., NIKOLAEVA, A., KOBYLIANSKAYA, A., GRAF, M. Spiral modes and the observation of quantized conductance in the surface bands of bismuth nanowires. In: *Scientific Reports*, 2017, 7, Article number: 15569.
2. YAMAJI, K. On the angle dependence of the magnetoresistance in quasi-two-dimensional organic superconductors. In: *J. Physical Society Japan*, 1989, 58, pp. 1520-1523.
3. KIKUGAWA, N., GOSWAMI, P., KISWANDHI, A., CHOI, E., GRAF, D., BAUMBACH, R. et al. Interplanar coupling-dependent magnetoresistivity in high-purity layered metals. In: *Nature Communications,* 2016, *7,* Article number: 10903.