2D to 3D weak localization dimensional crossover in $Ti_3C_2T_x$ MXene induced by thickness and defect engineering

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Due to their hydrophilic properties and very good metallic electrical behavior, MXenes are promising materials for numerous applications, including transparent conductive thin films. Therefore, there is a need to unravel the transport mechanism at stake in MXene multilayers. Although weak localization (WL) has been proposed as the dominating low-temperature transport mechanism in thin films, there have been however few attempts to model quantitatively temperature and magnetic field dependent resistivity measurements. In this talk, we will focus on the dimensionality of the low-temperature transport mechanisms in spin coated thin films of controlled thicknesses (from few tenth of nanometer to almost a micron) elaborated with the most-studied and metallic $Ti_3C_2T_x$ MXene. We will focus on the role of thickness and defects, as obtained from defect engineering through ion irradiation with various fluences. Low temperature and magnetic field dependent resistivity measurements were performed on such thin films and we analyzed our data in the framework of both two dimensional and three dimensional WL models: we will demonstrate a non-trivial evolution between the two behaviors and discuss the validity of both models.