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Scanning Tunneling Microscope Study of the van der Waals Ferromagnet CrCl3

CrCl3 is a van der Waals material particularly interesting for its magnetic properties. In each layer, the Cr atoms are coordinated in an octahedral configuration to the neighboring Cl atoms (Cr-Cl bonds are off-plane and the Cr atoms form a honeycomb lattice). The Cr atoms are coupled ferromagnetically via super-exchange and their magnetic moments lie in-plane. Its magnetic properties have been extensively studied in the bulk form [1], it is a weak ferromagnet with a curie temperature of 17 K. Recently, X-ray Magnetic Circular Dichroism was employed to show that it remains ferromagnetic down to the monolayer, with a Curie temperature very close to the one of the bulk material [2]. Motivated by these findings we have investigated the CrCl3 monolayer on the Au (111) surface. In this communication I will show our Scanning Tunneling Microscopy (STM) investigation.
CrCl3 was deposited by molecular beam epitaxy on the Au (111) surface, where it forms large monolayer islands of a width of several hundreds of nanometers. Our STM study shows that the lattice parameters of CrCl3 are close to the ones of the free layer, indicating a weak structural interaction with the Au substrate. Upon cooling the sample to 4 K, we observed the appearance of a superstructure with a period of about 6 nm. This superstructure displays dislocations with a Burgers vector of 2. We found that the superstructure originates from a peculiar kind of moiré effect between the CrCl3 monolayer and the Au substrate: a second order moiré. This effect has previously been reported only for systems with a large rotation between the two layers [3] and leads to some interesting properties, amongst them the fact that an edge dislocation with B=1 in the CrCl3 crystalline lattice is transformed in a B=2 dislocation of the moiré super-lattice.

References
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