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Can Carbon Be Ferromagnetic? H. OHLDAG, SSRL, T. TYLISZCZAK, ALS, R. HÖHNE, P. ESQUINAZI, D. SPEMAN, M. UNGUREANEAU, T. BUTZ, University Leipzig — While conventional wisdom says that magnetic materials have to contain some metallic atoms, the possibility of intrinsic magnetic order in pure metal free carbon materials is of fundamental interest because of the role of carbon as an elemental building block of organic as well as inorganic matter and last but not least of the tremendous interest in the electronic properties of graphene based structures. The common controversy raised across all disciplines in this matter is whether the magnetism of carbon is intrinsic or induced by other elements. We address this controversy by providing clear experimental evidence that metal free carbon can be ferromagnetic at room temperature using dichroism x-ray absorption spectro-microscopy. For this purpose we acquired soft x-ray microscopy images of magnetic structures on a thin carbon film that have been produced by irradiation with a focused 2.25MeV proton beam. Our element specific magnetic probe shows no indication of magnetically ordered Fe, Co or Ni impurities in these samples. Combination of the microscopy data with element specific spectroscopy and hysteresis measurements shows furthermore that only the carbon π-electronic states contribute to the long range ferromagnetic order of the sample.

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