µSR study of hydrogen interactions with defective graphene

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Macroscopic quantities of graphene, prepared by different chemical methods [1], have been investigated by Muon Spin Rotation. The implanted muons capture an electron and form muonium (Mu), an isotope of hydrogen with similar chemical behaviour. In all the investigated samples a clear oscillation in the time dependence of the muon polarization is observed, while it is missing in graphite, where juSt a slow Korringa-like depolarization is observed [2]. A zero field precession signal is usually the fingerprint of long range magnetism, but in this case the observation that: 1- the treatment of samples with molecular hydrogen at moderately high temperatures (800°C) induces a relevant increase of the precession signal amplitude, and 2- the signal disappears if the treatment is made with deuterium, indicates that origin of this precession is the dipolar interaction of the muon with the H nucleus [3]. The analysis of the muon spin precession under the hypothesis of the formation of a Mu-H entangled state suggests an inter-nuclear distance of 1.75 Å, fully compatible with a CHMu group. This witnesses an exceptional capture efficiency of mono-hydrogenated defects of graphene for atomic hydrogen (muonium in our case), to form an highly stable di-hydrogenated defect whose structure is shown in Figure 1. The exceptional stability of this moiety is confirmed by the persistence of the precession signal up to 900°C.

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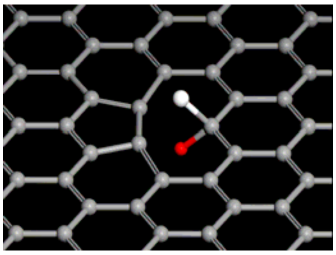

Figure 1. CHMu defect formed by the Muonium capture by an hydrogenated carbon vacancy.

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