$^{13}$C NMR study of the Zero-gap state in $\alpha$-(BEDT-TTF)$_2$I$_3$ under pressure

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The title material had recently been confirmed to be in a Zero-gap state (ZGS) with a Dirac-cone type dispersion relation for a massless fermion by theoretical analysis [1,2]. Experimental evidences for ZGS have been accumulated by precise transport measurements [3]. We performed $^{13}$C NMR study at 1.1GPa [5] and found the local susceptibility becomes quite different from molecule to molecule in the unit cell as approaching the ZGS under pressure. We experimentally confirmed that the most/least charged site, the B/C-molecule, carries the smallest/largest local susceptibility. This is considered as due to the nature of 'tilted' ZGS, since theoretical calculations [4] well agree with our observation. We also confirmed a linear temperature dependence of susceptibility at low temperatures, which is characteristic for the ZGS and consistent with the theory [4].

The pressure of 1.1 GPa was not high enough to stabilize the ZGS below 50 K. In the present study, we have carried out $^{13}$C NMR measurements under pressure of 1.8GPa, which stabilizes the ZGS at low temperatures. We used a single crystal of 10%-$^{13}$C enriched ET$_2$I$_3$ salt, in which the determination of local susceptibilities and the analysis of electronic properties became straightforward because of the absence of nuclear dipolar interactions.