

Embedding $S = 1/2$ Kagome-like Lattice in Reduced Graphene Oxide

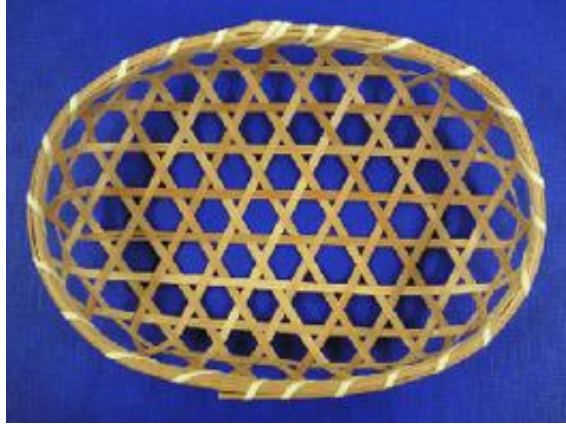
Kriti Gupta



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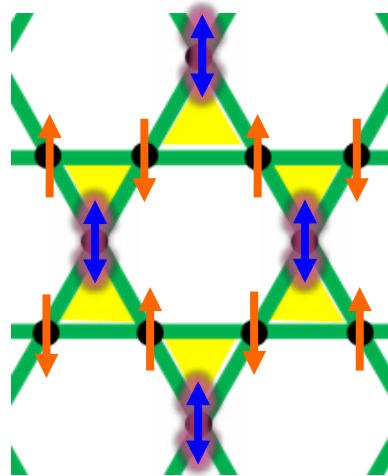
Kagome

Japanese Basket



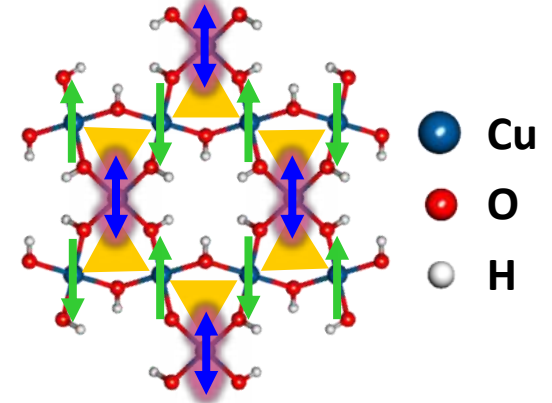
Corner sharing triangles

Kagome Lattice

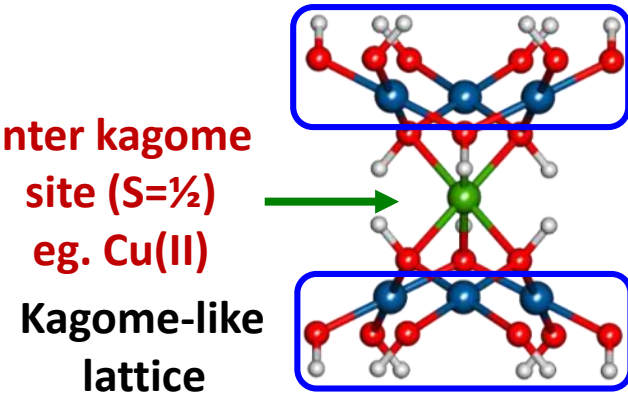


Possible Spin Liquid

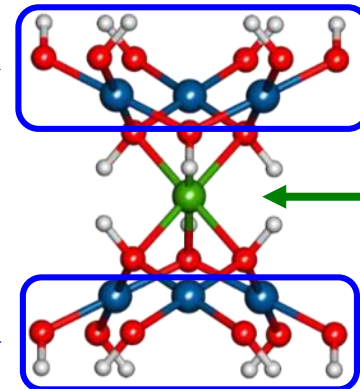
Clinoatacamite $\text{Cu}_2(\text{OH})_3\text{Cl}$; $S = \frac{1}{2}$



Naturally occurring mineral
Possible Quantum Spin Liquid

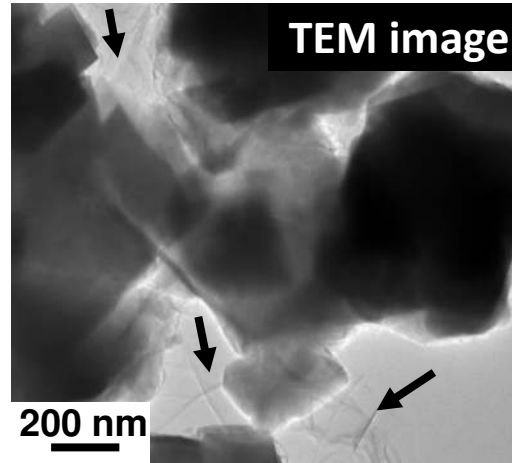
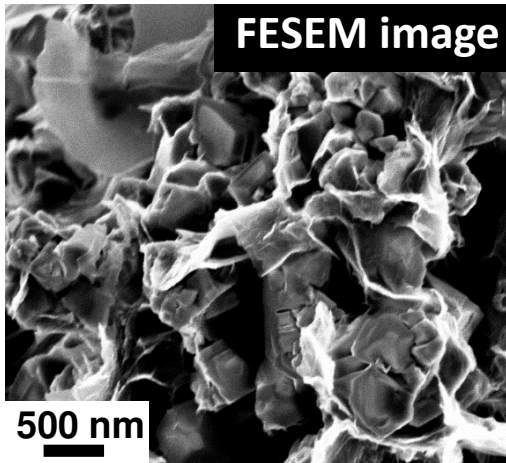
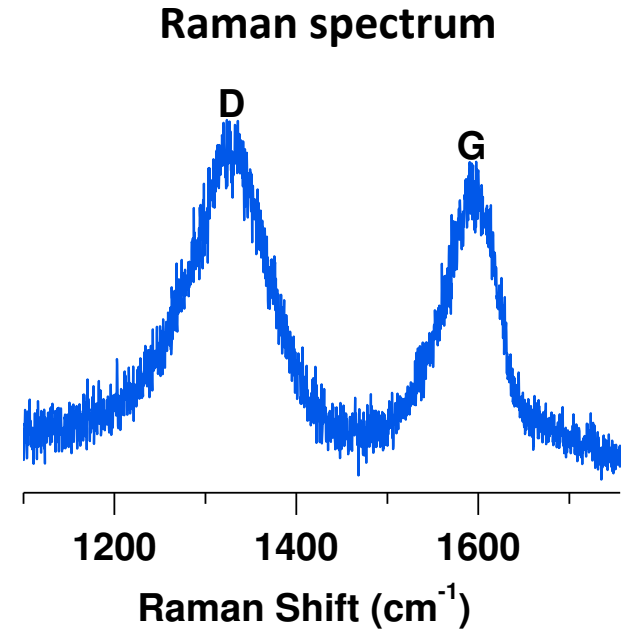
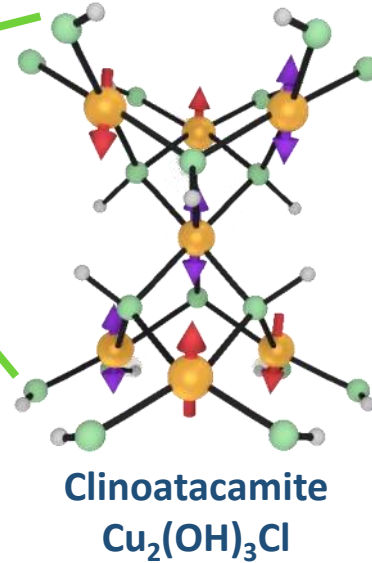
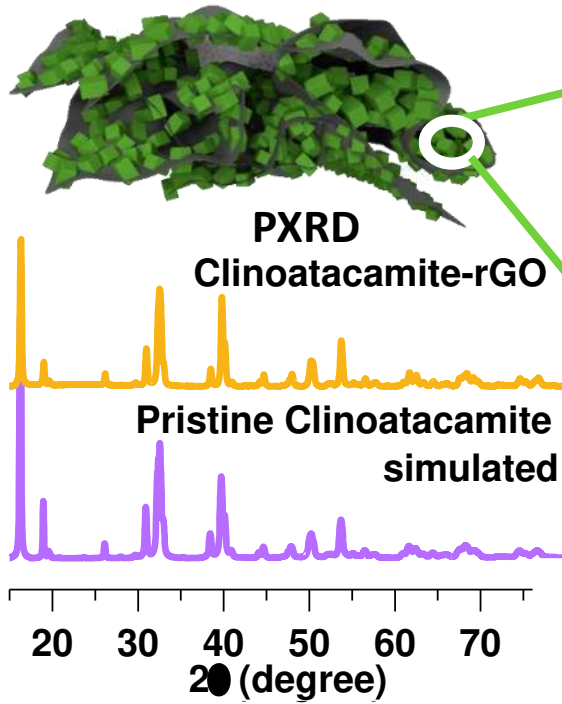


← Kagome plane →



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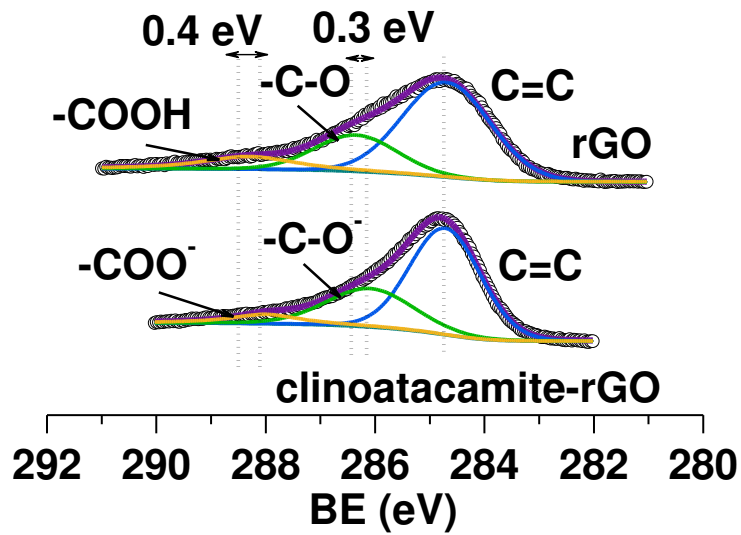
What if this frustration is perturbed with a semiconductor..?



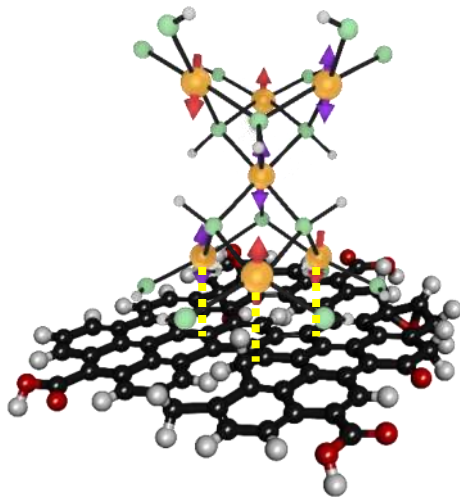
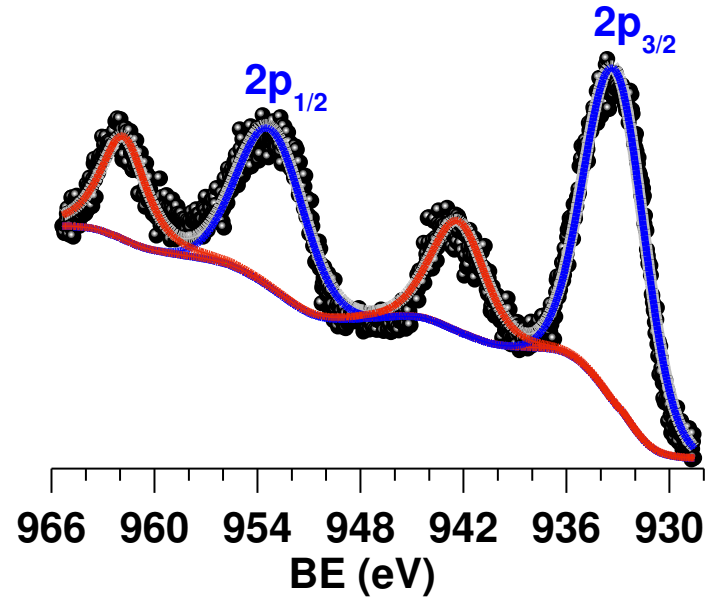
Clinoatacamite crystallites are wrapped by rGO sheets

Is there any chemical interaction between the two..?

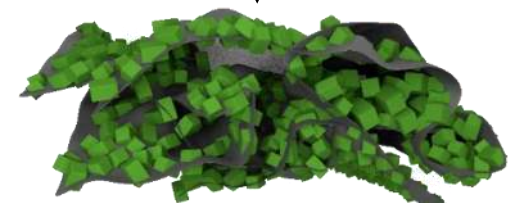
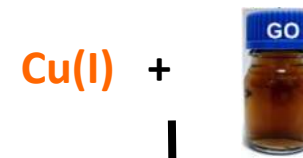
C 1s XPS spectra



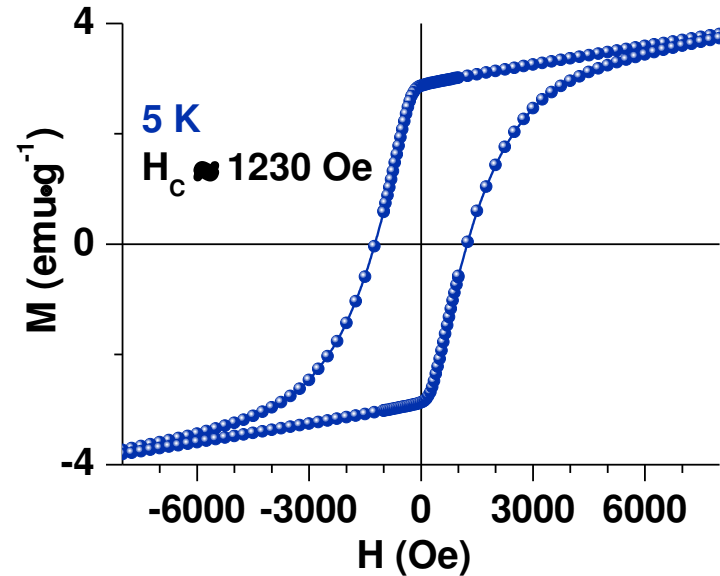
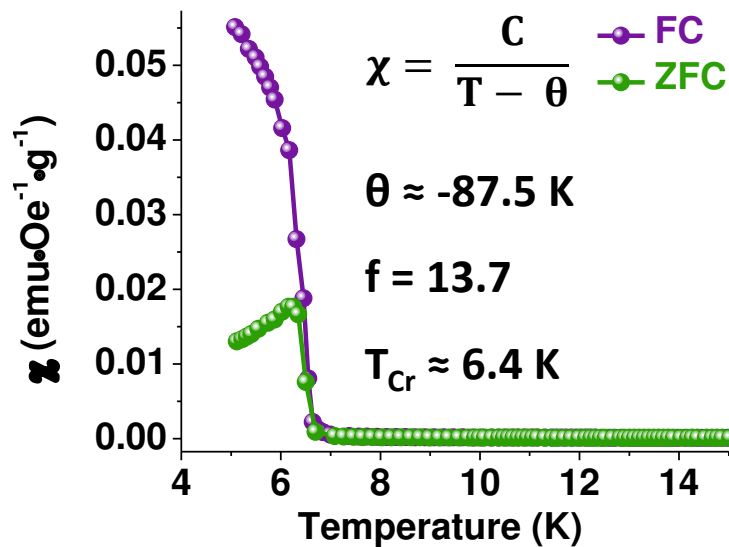
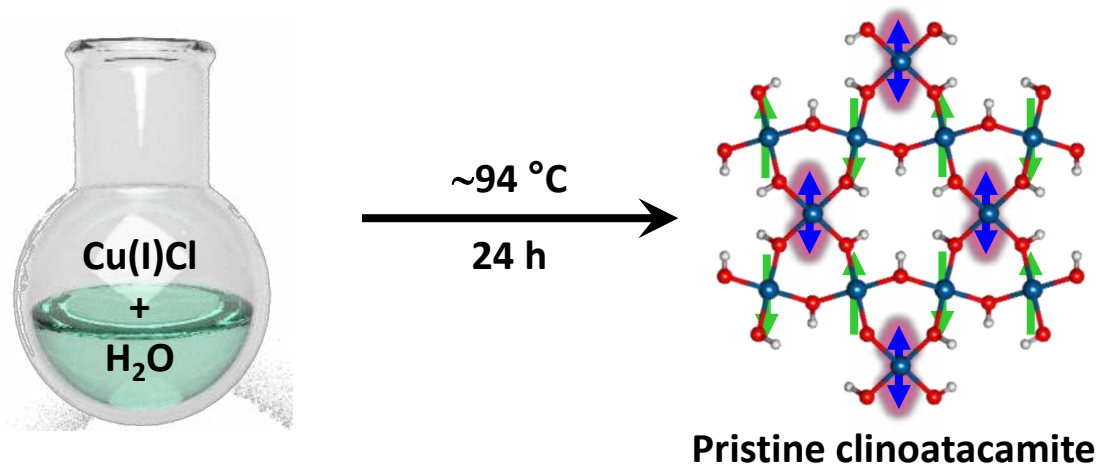
Cu 2p XPS spectra

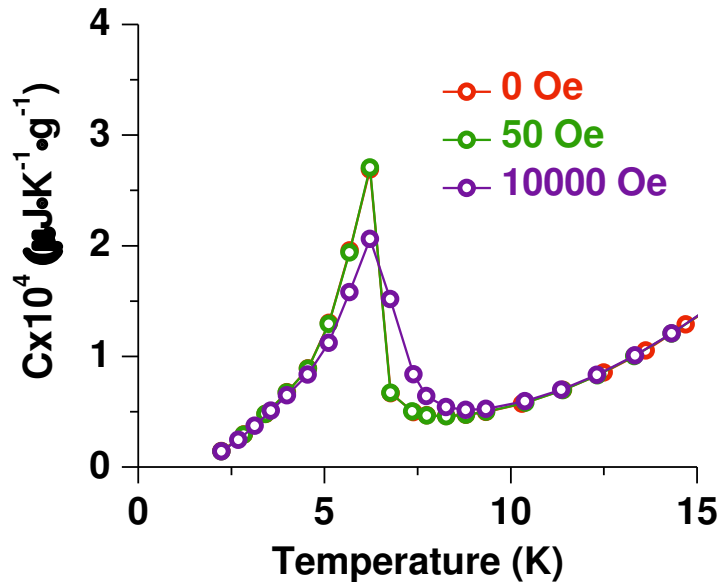
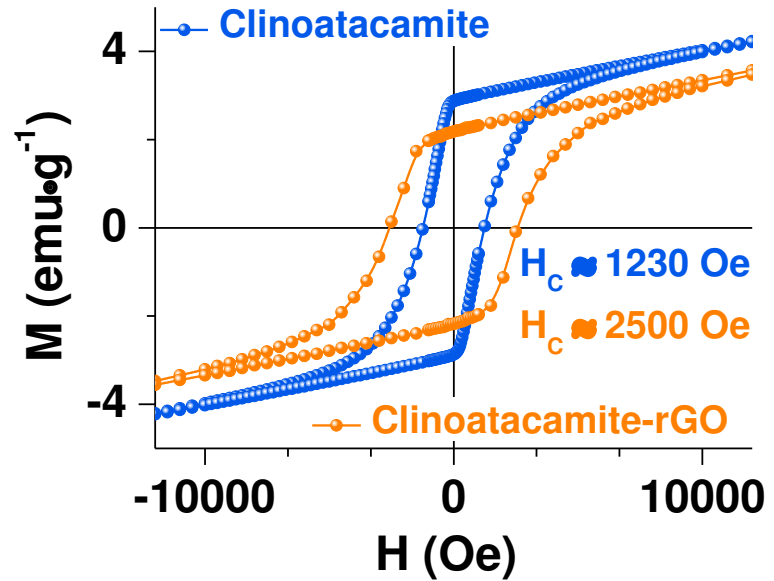
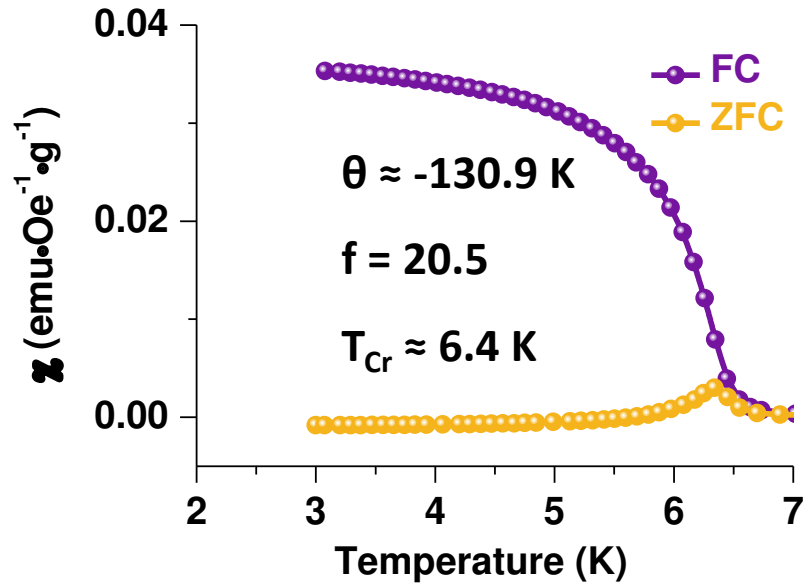


Clinoatacamite crystallites and rGO sheets are indeed chemically bonded

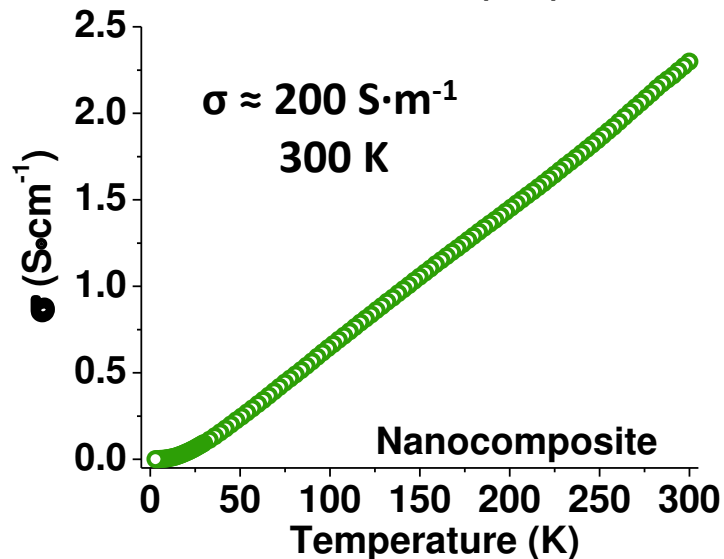
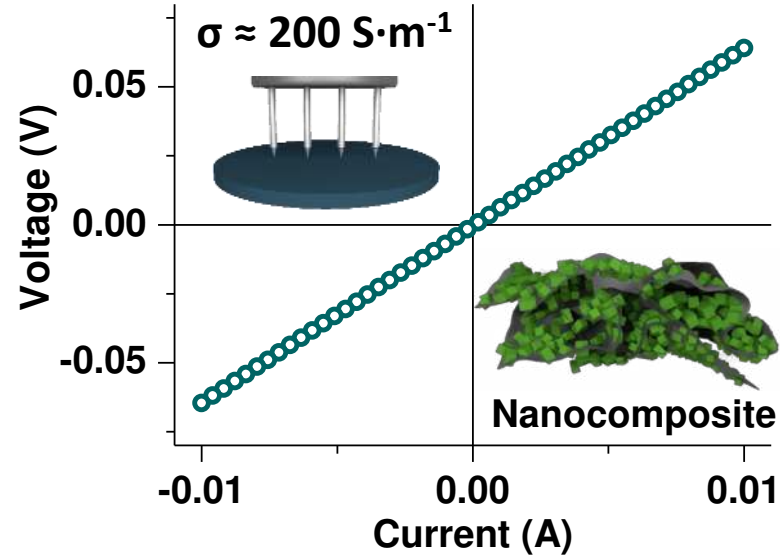
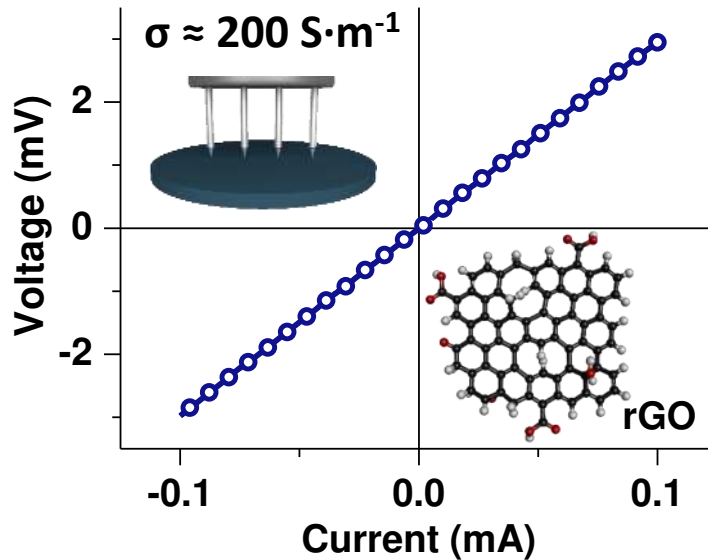


Clinoatacamite(Cu(II))-rGO



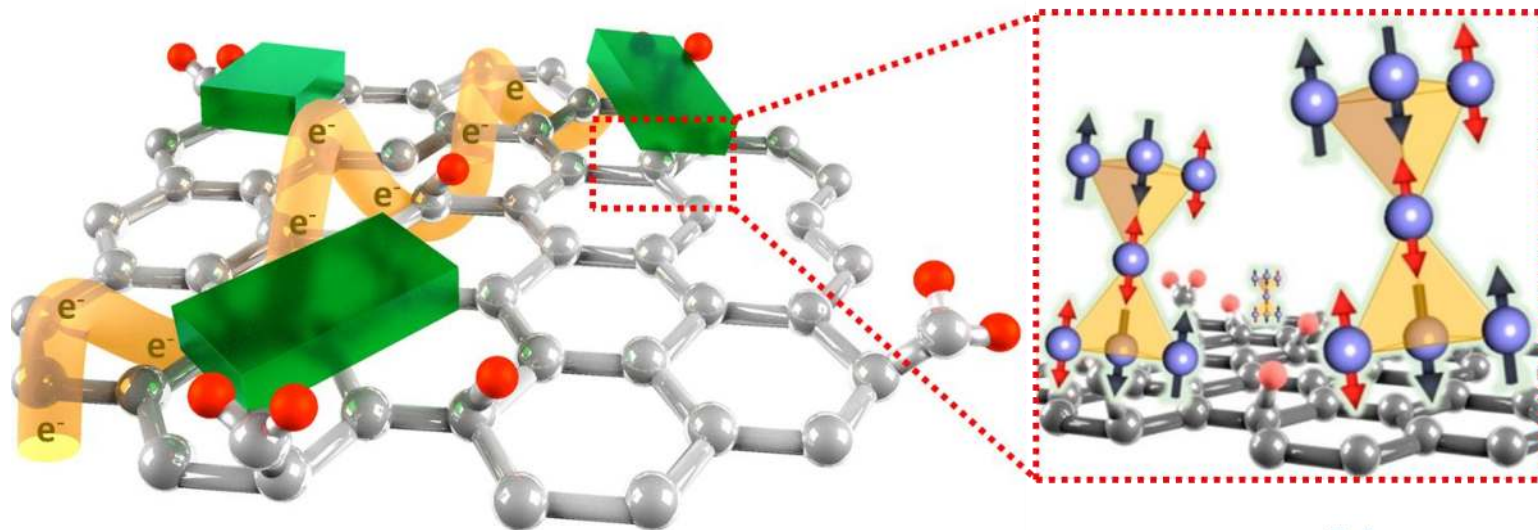


- Enhanced coercivity assigned to interaction between clinoatacamite crystallites via rGO matrix
- Spin arrangement/anisotropy induced by rGO at the interface could also enhance the coercivity



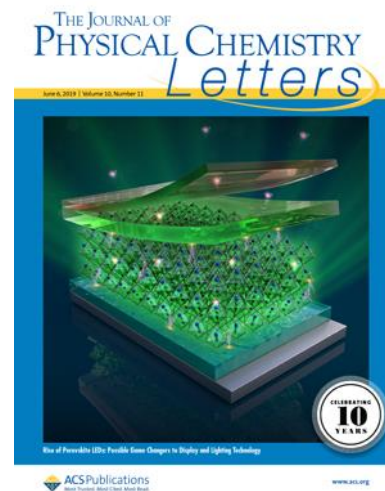
- Electrical conductivity of mechanical mixture was $\sim 35 \text{ S}\cdot\text{m}^{-1}$
- Clinoatacamite-rGO nanocomposite was found to be a semiconductor

Effect of external magnetic field on electrical response



- **In situ** formation of clinoatacamite onto rGO sheets from using simple oxidation-reduction reaction

$$\text{Cu(I)} + \text{GO} \longrightarrow \text{Clinoatacamite(Cu(II))-rGO}$$
- $S = \frac{1}{2}$ Kagome-like lattice onto rGO sheets – a new type of magnetic semiconductor
- Scope to extend this approach for other magnetic insulators to synthesize a fundamentally interesting new class of magnetic semiconductors



K. Gupta *et al.*
J. Phys. Chem. Lett.
2019, *10*, 2663-2668

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