"Weighing" atoms with electrons

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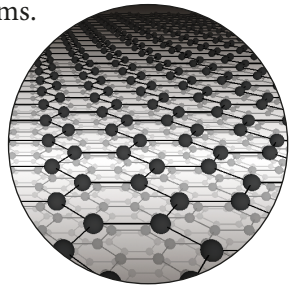
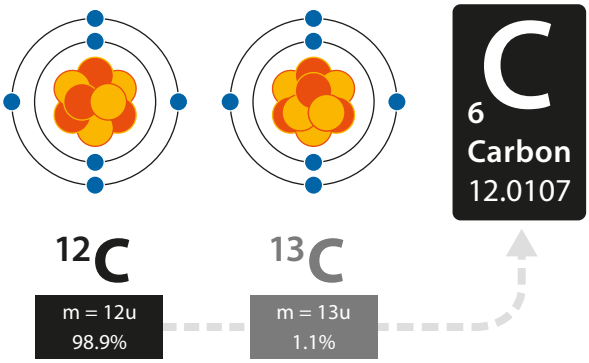
All materials are made up of atoms.

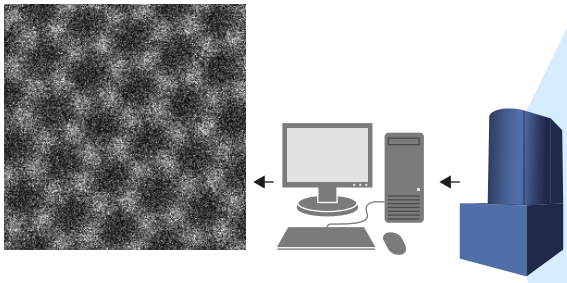
The "lead" in a pencil is actually **graphite**, a material made of stacked sheets of carbon atoms. A single sheet is called **graphene**.



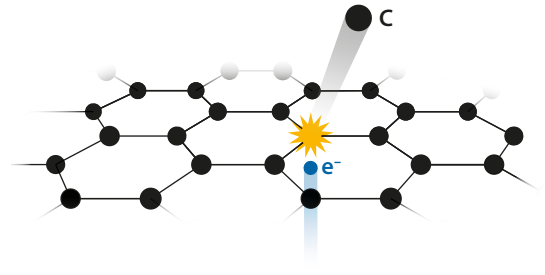


A carbon atom has six **protons** and six **electrons**, and comes in two stable variants called isotopes: ^{12}C and ^{13}C. The only difference is one more **neutron** in the ^{13}C nucleus.

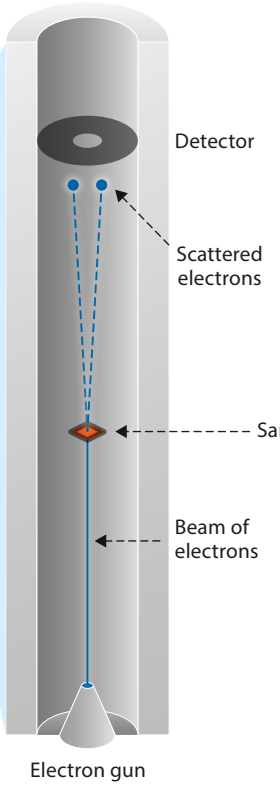
Although atoms in graphene can be "seen" by shooting electrons through the material in what is called **transmission electron microscopy**, different isotopes such as ^{12}C and ^{13}C appear identical.



However, the **electrons** sometimes eject atoms from the material.

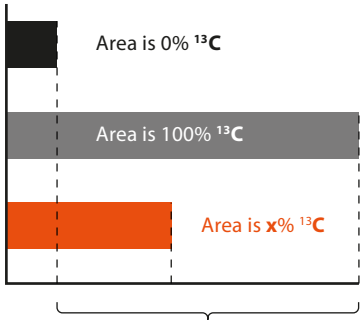


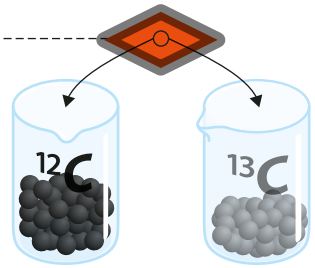
Scanning transmission electron microscope



The lighter the atom, the fewer electrons are on average needed to eject it.

ELECTRONS UNTIL EJECTION





Measuring isotopes can help understand and improve the synthesis of materials.

DISORDER+ MATERIALS

T. Susi, C. Hofer, G. Argentero, G.T. Leuthner, T.J. Pennycook, C. Mangler, J.C. Meyer & J. Kotakoski. Isotope analysis in the transmission electron microscope. *Nature Communications* 7:13040 (2016) DOI: 10.1038/ncomms13040