Topological Quantum Chemistry and the Topological Periodic Table of Materials

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One newly discovered characterization of insulators, metals and semimetals is based on their topological properties. Topological insulators do not conduct in the bulk but, unlike their non-Topological counterparts, exhibit perfect conduction on their surface. Topological metals conduct in the bulk, but, unlike their non-Topological counterparts cannot be gapped due to a special type of protection that allows their low energy electrons to exhibit esoteric phenomena such as chiral anomaly or non-local transport. It was initially thought that the materials exhibiting these phenomena are very special and unique amongst all of the 140000 compounds known to humankind. We will present a review of these ideas and properties of topological materials. We will then show how, using a new theory called Topological Quantum Chemistry, we are able to now catalogue all the topological materials that can possibly exist in nature. We then apply our theory to find that more than 27% of all known compounds - including some of the most interesting materials in nature - are actually topological. We hence live in a topological world!