

Origin of altermagnetism and quasi-altermagnetism through the lens of chemical bonding

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In recent years, altermagnets have drawn significant attention in the realm of magnetism due to their unconventional properties. In particular, the symmetry-driven spin-splitting of bands in momentum space with compensated magnetism opens a new avenue to study various electronic properties in the framework of compensated magnetism with broken time-reversal symmetry. While a lot of research is being carried out in designing the futuristic quantum devices using altermagnet, the fundamental understanding of the origin of altermagnetism is still evolving. The existing group theory can only provide a binary description of the existence of altermagnetism, not a quantitative one. The latter is crucial for device application. Therefore, we have studied the origin of altermagnetism in the framework of chemical bonding, which naturally includes the crystal and orbital symmetries together. As a result, it provides a quantitative description of the altermagnetic spin-splitting and is tunable. Most importantly, we identified the deterministic chemical bonding that drives the altermagnetism. Furthermore, we have proposed a new class of magnetism, “quasi-altermagnetism”, which differs from both altermagnetism and compensated ferrimagnetism, and we have explained its chemical-bonding origin. This study prepares fertile ground for the development of chemical-bonding-driven selection rules for the classification of different types of magnetism.

References:

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