Green Grignard reactions? Research-inspired sustainable chemistry practicals

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Abstract

Chemists have always pursued sustainable reactions, even when this was not framed "Green Chemistry", which became *en vogue* once Paul Anastas championed it.[1] Since the discovery of the Grignard reaction as a means of forming new carbon-carbon bonds have chemists sought to understand the mechanism and searched for ways to simplify the practical aspects of this and other nucleophilic additions of (transition)metal-based carbon nucleophiles. Victor Grignard and Paul Sabatier used anhydrous conditions and Wilhelm Schlenk described the influence of ethers on the equilibrium of the reactive species of Grignard reagents. Not much has changed in more than a century until Koji Kubota, Hajime Ito *et al.*[2] described a mechanochemical variant of the Grignard reaction in 2021.

At the University of Southampton, we have always sought to include sustainability aspects from chemistry and chemical engineering in our teaching laboratories and to inform our undergraduate practicals by recent research[3]. In the context of Grignard reactions, we developed a new undergraduate experiment that contrasts the traditional and the sustainable way of synthesising Grignard reagents based on this novel approach. This has allowed us to touch upon techniques used by organometallic chemists as well as by material scientists: It has emboldened our students to explore green chemistry metrics as well as the 12 principles of green chemistry; and inspired us to implement a systems thinking approach in practical teaching when introducing an environmentally friendly pathway of this time-honoured reaction.

References

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