Photoredox C–C cross-couplings using boronic acid derivatives
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Abstract: Carbon-centred radicals are a synthetically powerful class of reactive intermediates that are particularly attractive in the C–C bond formation due to their ability to circumvent problems intrinsic to 2-electron processes. Using visible light-mediated single electron transfers, photoredox catalysis has enabled the generation of carbon radicals in a mild and selective fashion. It is widely known that organoborates, containing electron-rich B(sp3) moiety, can be subjected to single electron oxidation to generate a neutral carbon radical after C–B cleavage (see (A)). Due to their high oxidation potentials, radical generation from boronic acid derivatives is underdeveloped. We discovered that boronic acids and esters can undergo similar single electron oxidation when their empty p-orbital is complexed with a Lewis base (LB, see (B)). With this knowledge, we developed reaction conditions to utilise these boronic acids and esters species in synthetically useful C(sp2)–C(sp3) and C(sp3)–C(sp3) radical based cross-couplings. This dual photoredox and Lewis base catalyst system provides an alternative activation mode for these common and widely available reagents.

Keywords: Boronic acids; Cross-coupling; Lewis base catalysis; Photoredox catalysis; Synthetic methods