

# Highly Efficient Functionalization and Covalent Patterning of Graphene by Photoactivation

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Since its first isolation, graphene has remained at the forefront of materials research owing to its remarkable electronic, mechanical, and optical properties.<sup>[1-2]</sup> These unique characteristics hold the potential to revolutionize material applications similar to how polymers did in the past. However, its practical implementation is hindered by poor processability, arising from insolubility, and by the absence of an intrinsic bandgap, which limits its use in electronic devices such as transistors. To overcome these limitations, structural modification strategies have been explored, with chemical functionalization emerging as particularly promising. Covalent grafting of functional groups onto graphene can enhance its dispersibility and induce a tunable bandgap, thereby tailoring its properties for specific applications.<sup>[3-4]</sup> Yet, the high chemical inertness of graphene renders covalent modification challenging. Although various reactions on the carbon lattice have been reported, functionalization yields are typically low, and efficient modification often requires harsh conditions, such as plasma treatment, electrochemical activation, or the use of strong reducing agents, which demand specialized equipment and expertise.<sup>[5-7]</sup> Consequently, accessible and efficient routes for the covalent modification of substrate-supported graphene remain scarce. Here, we present facile and scalable approaches for the light-induced covalent functionalization of graphene employing non-toxic and readily available iodonium salts as active reagents. Upon photoexcitation of graphene, the planar carbon lattice reacts efficiently with these reagents, affording high functionalization yields under mild reaction conditions. Furthermore, spatially controlled modification with micrometer-scale resolution is achieved, enabling the integration of pristine and functionalized regions within a single sample. This method offers a versatile and accessible platform for tailoring graphene's properties towards future applications.

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