ACCOUNTS
of chemical research

GUEST EDITORIAL

Graphene: Noble No More

While there is still debate about the electronic structure of graphene and whether it should be considered to be a metal, for practical purposes the observation of a work function is sufficient to justify this classification. From the standpoint of chemistry, graphene was accorded the status of a noble metal because graphite is considered to be inert to all but the most forcing of reaction conditions. Indeed graphite has a large overpotential in electrochemical oxidation processes, and thus the thermodynamic oxidation potentials of the material do not fully capture the resistance of graphite toward oxidation. Furthermore, graphite is the thermodynamic reference for carbon and the most energetically stable of the allotropes. The preparation of the traditional compounds of graphite such as graphite oxide, graphite fluoride, and the graphite intercalation compounds require forcing conditions, but the Accounts in this volume disclose far more nuanced approaches to the large scale functionalization of graphene. These developments seem likely to continue as more chemists become involved. While some of the reactions that are reported had been previously demonstrated to be effective in the surface or bulk functionalization of graphite, many of the reactions break new ground (Scheme 1).

While many authors choose to obtain graphene from natural sources through the exfoliation of graphite, there are a large number of approaches to the production and destruction of graphene that are detailed in this issue (Scheme 2).

The investigation and application of the properties of graphene are areas of active investigation, and many of the Accounts in this volume touch on one or more of these aspects of graphene science and technology (Scheme 3).

Graphene may be regarded as the third wave of the new carbon allotropes, although it has been in our hands for many years. The advent of the carbon fullerenes and nanotubes gave rise to outstanding new science, and in some respects, the properties of these carbon materials are unsurpassed. It is the final step that has been the most difficult to accomplish, the realization of widespread applications.

There are many applications that can be envisaged for carbon nanotubes and graphene, but the most intriguing property is the outstanding performance of these materials in electronic devices. This performance far surpasses that of silicon, and it may be that one or some hybrid of these materials will succeed in this arena. The present issue offers a series of illuminating Accounts on the chemistry, synthesis, properties, and potential applications of graphene. These Accounts serve as an excellent introduction to graphene and its relevance to chemistry.

Robert C. Haddon
Guest Editor

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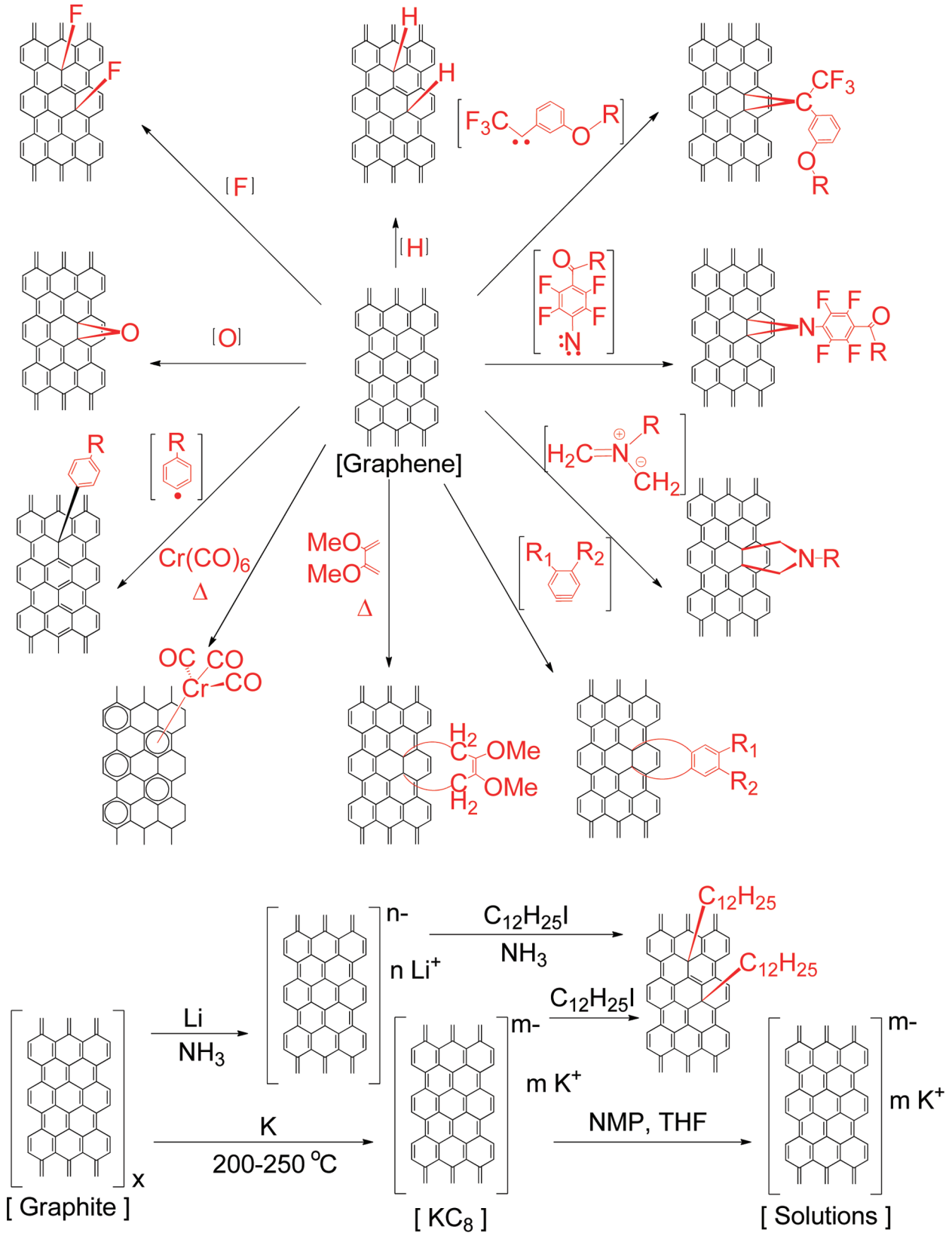
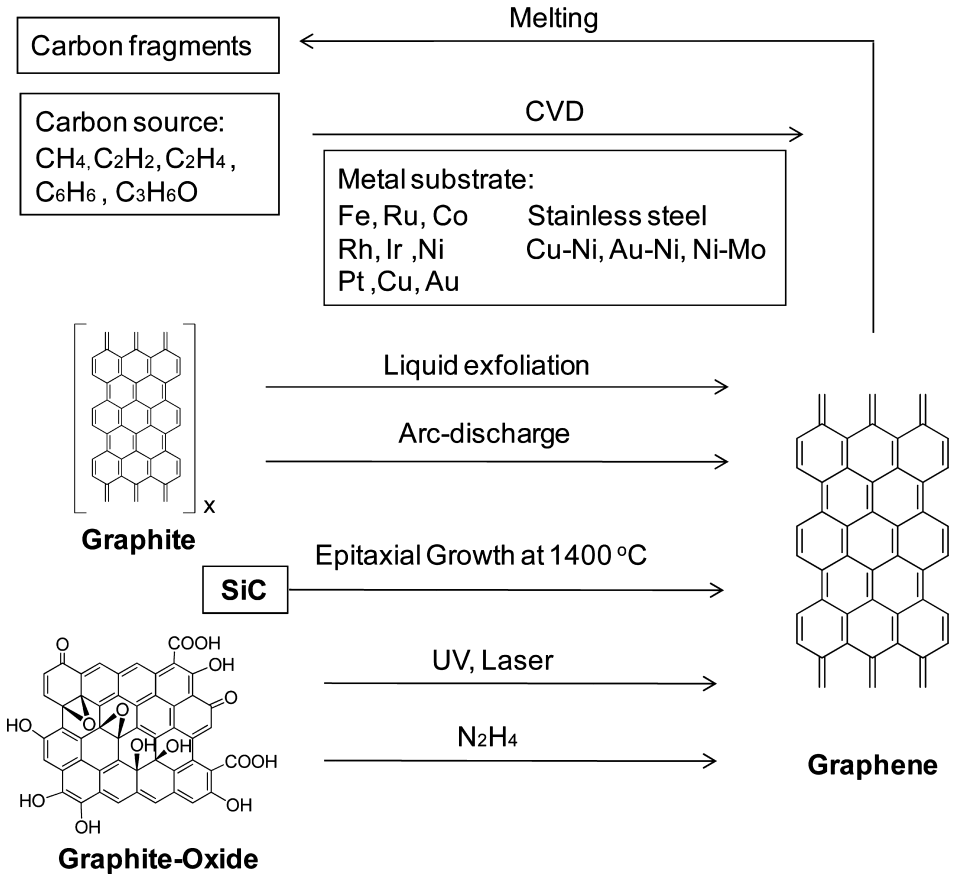
SCHEME 1. Functionalization of Graphene



SCHEME 2. Synthesis of Graphene



SCHEME 3. Properties and Applications of Graphene