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Nanosized ruthenium particles decorated carbon nanofibers as active catalysts for the oxidation of p-cymene by molecular oxygen

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Highly dispersed, nanosized ruthenium (Ru) particles anchored on carbon nanofibers (CNFs) with varying Ru loadings (1–7 wt.%) showed effective catalytic activity in the aerobic oxidation of p-cymene using molecular oxygen. The activity of the Ru catalysts was influenced by the structural properties that resulted from the different metal loadings and by various reaction variables, such as the temperature, the amount of catalyst and the type of radical–initiator substrate. Under optimized reaction conditions, the 3%Ru/CNF catalyst exhibited excellent performance with a selectivity of 42% toward primary cymene hydroperoxide (PCHP) and 33% toward tertiary cymene hydroperoxide (TCHP) at 55% p-cymene conversion achieved within 5 h at 90 ◦C. The results demonstrated that the direct participation of the catalyst in p-cymene C H bond activation occurred via catalytic decomposition of tertiary-butyl hydroperoxide (TBHP), which was added as an initiator, into a free-radical chain initiator rather than the direct H-atom abstraction by the catalyst itself. The catalytic efficacy displayed by the Ru/CNF catalysts provides encouraging results for the activation of C H bonds of liquid-phase alkyl aromatic hydrocarbons, such as p-cymene, toward the introduction of an oxygen atom. The catalyst was reusable for five consecutive reaction cycles without appreciable loss of activity. Moreover, Ru/CNF catalyst was active for extended substrate scope application in the oxidation of other alkyl-substituted aromatics.