Sonogashira Coupling with Bimetallic Pd–Au Nanoparticles on Carbon

\[
Pd(OAc)_2 + KAuCl_4 + H_2 (1 \text{ atm}), \text{ charcoal} \rightarrow Pd–Au/C \quad (1)
\]

\[
\begin{align*}
\text{R}^1\text{I} + \text{nPd–Au/C (2 mol% Pd)} & \rightarrow \text{R}^1\text{R}^2 \\
\text{K_3PO_4, i-PrOH–H_2O (1:1)} & \rightarrow 80 \degree C, 20 \text{ h} \\
& \rightarrow \text{18 examples up to 95\% yield}
\end{align*}
\]

Selected results:

- 73\% yield
- 70\% yield
- 91\% yield
- 87\% yield
- 70\% yield
- 95\% yield

\[
\begin{align*}
\text{Pd–Au/C or Pd/C (1 mol% Pd)} & \rightarrow \text{K_3PO_4, i-PrOH–H_2O (1:1)} \\
& \rightarrow 80 \degree C, 12 \text{ h} \\
& \rightarrow \text{1st run 2nd run 3rd run 4th run 5th run} \\
Pd–Au/C & 86 74 71 68 65 \\
Pd/C & 86 74 71 68 49
\end{align*}
\]

**Significance:** Bimetallic palladium–gold nanoparticles on carbon (Pd–Au/C) were prepared by treatment of a mixture of Pd(OAc)_2, KAuCl_4 and charcoal in methanol with H_2 (eq. 1). Pd–Au/C catalyzed the Sonogashira coupling of aryl iodides with terminal alkynes under copper-free conditions to give the corresponding diaryl alkynes in up to 95\% yield (18 examples, eq. 2).

**Comment:** The Pd–Au/C nanoparticles were characterized by TEM, XRD, STEM-EDX, XPS and CV analyses. Though the catalytic activity of fresh Pd–Au/C was similar to that of fresh Pd/C, Pd–Au/C showed high stability during the recycling experiments (eq. 3). TEM analysis showed that the morphology of the recovered Pd–Au/C was unchanged after the third run.