Sonogashira Coupling with Bimetallic Pd–Au Nanoparticles on Carbon

\[
Pd(O\text{Ac})_2 + K\text{AuCl}_4 \xrightarrow{\text{H}_2 (1 \text{ atm}), \text{charcoal}} \text{MeOH}, 25 \degree C, 12 \text{ h} \xrightarrow{} Pd–Au/C (1)
\]

\[
\begin{align*}
R^1-I & + \equiv R^2 \xrightarrow{\text{Pd–Au/C (2 mol% Pd)}} \xrightarrow{K_3\text{PO}_4, \text{iPrOH–H}_2\text{O (1:1)}} \xrightarrow{80 \degree C, 20 \text{ h}} \text{R}^1\equiv\text{R}^2 \\
18 \text{ examples} & \text{up to 95% yield}
\end{align*}
\]

Selected results:

- 73% yield
- 70% yield
- 91% yield
- 87% yield
- 70% yield
- 95% yield
- 68% yield
- 69% yield
- 73% yield
- 91% yield
- 73% yield
- 68% yield
- 74% yield
- 68% yield
- 65% yield
- 46% yield
- 50% yield
- 49% yield

**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.