

# Low temperature selective oxidation of methane to methanol using titania supported gold palladium copper catalysts

Mohd Hasbi Ab Rahim,<sup>‡</sup> Robert D. Armstrong, Ceri Hammond, Nikolaos Dimitratos, Simon J. Freakley, Michael M. Forde, David J. Morgan, Georgi Lalev, Robert L. Jenkins, Jose Antonio Lopez-Sanchez, Stuart H. Taylor and Graham J. Hutchings\*

<sup>†</sup> *Electronic supplementary information (ESI) available. See DOI: 10.1039/c5cy01586c*

<sup>‡</sup> *Current Address: Faculty of Industrial Sciences & Technology, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300, Kuantan, Pahang, Malaysia.*

## Abstract

The selective oxidation of methane to methanol has been studied using trimetallic AuPdCu/TiO<sub>2</sub> catalysts prepared by incipient wetness impregnation. They are able to catalyse the selective oxidation of methane to methanol under mild aqueous reaction conditions using H<sub>2</sub>O<sub>2</sub> as the oxidant. When compared with bimetallic, Au–Pd/TiO<sub>2</sub> analogues, the new trimetallic catalysts present productivities which are up to 5 times greater under the same test conditions, and this is coupled with methanol selectivity of up to 83%. Characterisation shows that whilst Au–Pd is present as Au-core–Pd-shell nanoparticles, copper is present as either Cu or Cu<sub>2</sub>O in <5 nm particles.

DOI: 10.1039/c5cy01586c