Photocatalytic challenge of carbon dioxide conversion into fuels supported by spectroscopy
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Photocatalytic conversion of CO₂ into fuels explores a route to carbon-neutral fuels, avoiding the net increase in atmospheric CO₂ concentrations associated with fossil-derived alternatives.1 Intensive studies have been reported for the CO₂ photoconversion, however, the development of good catalyst, the optimization of reaction conditions, and the understanding of efficient photocatalytic mechanism are still required for the future applications.2

As a new type of photocatalysts for the CO₂ photoconversion, we previously investigated layered double hydroxides (LDHs), typically comprising Zn, Cu, and Ga/Al to form methanol.3 The doping of Ag nanoparticles on/in Zn₃Ga LDH was effective to enhance the selectivity to methanol (54 mol%) under the irradiation of UV–visible light and also the photoformation rates of CO and methanol under visible light only while Au doping was ineffective.4 The reason was explained based on the excitation of Ag/Au nanoparticles by visible light and that of LDH by UV light (Figure 1). Due to the level difference of conduction band of LDH and hot electrons at Ag/Au nanoparticles, effective electron flow finally to CO₂-derived species was enabled from Ag to Zn₃Ga LDH as monitored by X-ray absorption fine structure (XAFS) and UV–visible spectroscopy.

Pretreatment and photocatalytic reaction conditions were investigated for Zn₃₋ₓCuₓGa LDHs (x = 0, 1.5). If the catalyst was preheated at 423 K and protected in argon, total formation rates of methanol and methane increased to 2.7 μmol h⁻¹ g⁻¹ at 0.40 MPa of CO₂ and H₂ gas due to the liberation of interlayer reaction space of LDH by removing one third of interlayer water molecules as monitored by XAFS.5 At the lecture, related recent progresses are also discussed.

References
# Curriculum Vitae

**Name**: Yasuo Izumi  
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<table>
<thead>
<tr>
<th>Fields of study</th>
<th>Catalysis</th>
<th>Environmental Chemistry</th>
<th>X-ray Spectroscopy</th>
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## Education & Jobs

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<tr>
<th>Date</th>
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<tr>
<td>Dec 1992</td>
<td>Research associate, Department of Environmental Chemistry and Engineering, Interdisciplinary Graduate School of Science &amp; Engineering, Tokyo Institute of Technology</td>
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<td>Jun 1996</td>
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## Representative papers


