物質科学セミナー
2019 年 5 月 2 7 日（月）午後 XX 時 XX 分–
3B213 プレゼンテーションルーム

Pulsed laser post processing of transition metal oxides for defect-engineering and catalysis research applications

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In the field of catalysis research and catalyst development, identifying and understanding structure-activity correlations in real-structure catalysts is essential for tailored catalyst design.[1] To study the latter, catalyst materials obtaining high purity and gradually increasing densities of active sites (e.g. point, 2D or 3D defects) are needed. Pulsed Laser Post Processing (PLPP) in liquids has shown to be a promising tool to tune nanomaterials' properties (e.g. band gap or photoluminescence) and potentially induce defect centres (like point-, line-, and planar defects) under high purity conditions.[2-5] Subsequent functionalization with surfactant-free laser generated co-catalysts enables further systematic studies on the nature of active centres present on the heterogenous catalyst during reaction.[5] Laser-based surfactant-free catalysts are usually active without any further pre-treatment steps required (calcination).[6]

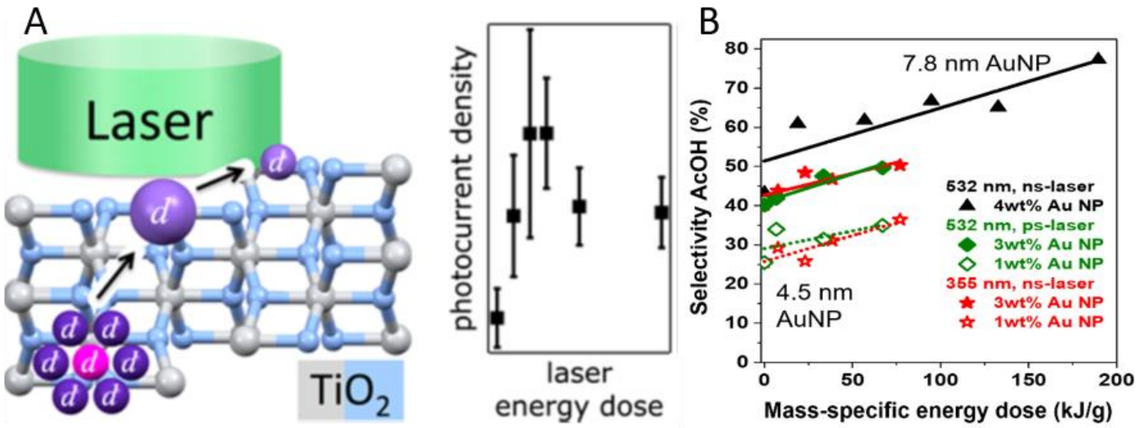

Fig. 1: Effect of Pulsed Laser Post Processing of AuNP-loaded TiO_2 on A : photocatalytic activity [5] and B : selective oxidation reactions.

Within this presentation, recent advances on laser-based defect-engineering of oxidic nanomaterials and its implication for the catalytic activity in different types of reaction (e.g. photocatalysis and selective oxidation catalysis) will be presented. It will be shown, that the optical properties and surface chemistry as well as the photocatalytic and catalytic activity during selective oxidation reaction of laser-treated oxide materials can be tuned during PLPP (see Fig. 1) by means of mass-specific energy dose using a modified liquid-jet setup operating under constant flow conditions. In this context, also the impact of inhomogenous irradiation conditions during PLPP will be addressed. Furthermore, the catalytic results will be discussed in terms of laser-based modifications of the morphology and the materials defect density.

1. A. J. Medford, A. Vojvodic, J. S. Hummelshøj, J. Voss, F. Abild-Pedersen, F. Studt, T. Bligaard, A. Nilsson, and J. K. Nørskov, *Journal of Catalysis*, vol. 328, pp. 36–42, 2015.
2. D. Zhang, J. Liu, P. Li, Z. Tian, C. Liang, *ChemNanoMat 3 (8)*, 512-533, 2017
3. M. Lau, S. Barcikowski, Appl. Surf. Sci., 2015, 348, 22–29
4. F. Waag, B. Goekce, C. Kalapu, G. Bendt, S. Salamon, J. Landers, U. Hagemann, M. Heidelmann, S. Schulz, H. Wende, N Hartmann, M. Behrens, S. Barcikowski, *Scientific Reports*, 7, 1-13, 2017
5. M. Lau, S. Reichenberger, I. Haxhiaj, S. Barcikowski, A. M. Müller, *ACS Applied Energy Materials* 1, 5366–5385, 2018
6. W. Dong, S. Reichenberger, S. Chu, P. Weide, H. Ruland, S. Barcikowski, P. Wagener, M. Muhler, *Journal of Catalysis*, *330*, 497-506 , 2015.

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