



Swiss Science Concentrates

A CHIMIA Column

Short Abstracts of Interesting Recent Publications of Swiss Origin

Side-chain Dynamics of the α_{1B} -Adrenergic Receptor Determined by NMR via Methyl Relaxation

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Protein Science **2023**, *32*, e4801

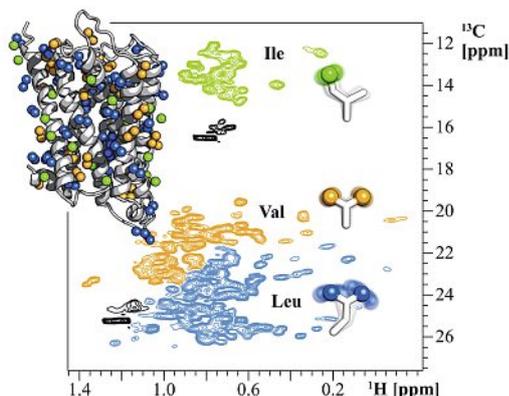
<https://doi.org/10.1002/pro.4801>

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This study explores the rapid side-chain dynamics of the thermostabilized α_{1B} -adrenergic receptor (α_{1B} -AR), a G protein-coupled receptor (GPCR) of considerable medical importance. GPCRs undergo relatively slow conformational transitions on the μ s-ms timescale, while their faster dynamics on the ps-ns timescales are modulated by the swift motions of amino acid side chains. These side-chain dynamics are pivotal for GPCR functions, such as ligand recognition and allosteric regulation. The investigation focuses on the behaviour of Ile, Leu, and Val methyl groups in the presence of different ligands, both orthosteric (prazosin and tamsulosin) and allosteric (conopeptide, ρ -TIA). ρ -TIA induces enhanced flexibility in specific Ile residues, indicating distinct mechanisms for orthosteric and allosteric receptor inactivation. Additionally, the rigidity of Ile side chains correlates with their proximity to the membrane bilayer's central region, characterized by denser packing and reduced protein surface exposure. In contrast, Leu side chains exhibit greater flexibility on average, primarily due to their presence in less densely packed regions with higher protein-surface exposure compared to Ile. These results provide valuable insights into the dynamic behaviour of GPCR side chains, offering a deeper understanding of their functional roles and ligand interactions.

Authors' comments:

“Side chain dynamics detected *via* methyl relaxation constitute a multi-probe approach for sensing side chain motions across the entire receptor potentially providing a very comprehensive picture of functionally relevant motions.”



A Machine-learning Tool to Predict Substrate-adaptive Conditions for Pd-catalyzed C–N Couplings

N. Ian Rinehart¹, Rakesh K. Saunthwal¹, Joël Wellauer², Andrew F. Zahrt¹, Lukas Schlemper², Alexander S. Shved¹, Raphael Bigler^{2*}, Serena Fantasia^{2*}, and Scott E. Denmark^{1*}

Science **2023**, *381*, 965–972.

<http://10.1126/science.adg21>

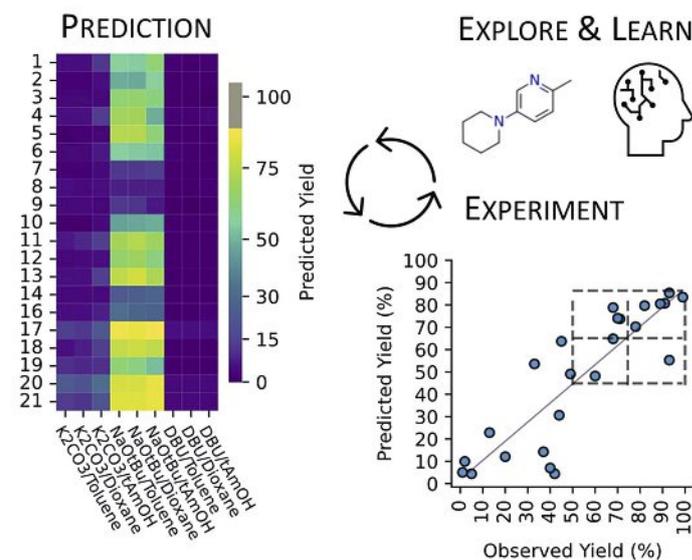
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Machine-learning techniques offer promising avenues for the rapid determination of reaction conditions in chemical transformations. In this study, a novel tool that predicts substrate-adaptive conditions for palladium (Pd)-catalyzed carbon-nitrogen (C–N) couplings is presented. The development of this tool involved the creation of an extensive experimental dataset, covering a wide range of reactant combinations across various reaction conditions. Neural network models were employed to actively learn a diverse set of C–N couplings, then select a ligand, base and solvent to furnish product in high yield. Experimental validation demonstrated that the tool accurately predicted high-yielding conditions, providing products in excess of 85% yield across a spectrum of couplings which employed out-of-sample reactants.

Authors' comments:

“The tool developed considers structures of both coupling partners and offers an interesting, data-driven alternative to current user guides. We expect this model to be widely useable, particularly because it can adapt and improve in domains of interest to the user by collecting data in this region of the chemical space.”



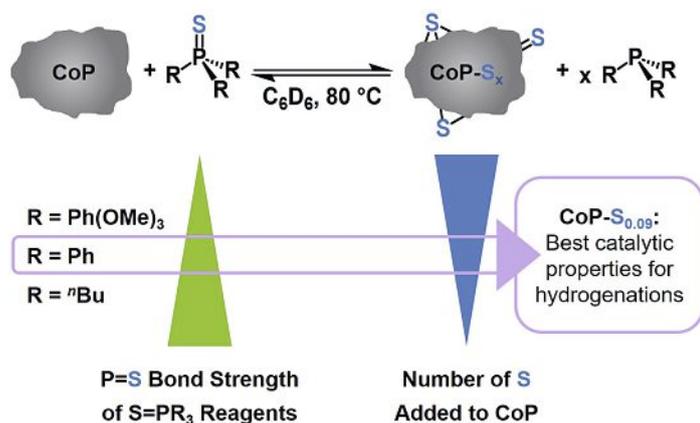
Controlled Surface Modification of Cobalt Phosphide with Sulfur Tunes Hydrogenation Catalysis

Nina A. Arnosti, Vanessa Wyss, and Murielle F. Delley*
J. Am. Chem. Soc. **2023**, *145*, 43, 23556–23567
<https://doi.org/10.1021/jacs.3c07312>
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Transition metal phosphides have shown promise as catalysts for water splitting and hydrotreating, particularly when incorporating sulfur in small amounts. Yet, the sulfur's precise catalytic influence remains unclear due to the conventional sulfur doping methods resulting in both internal and surface sulfur content. In this study, the authors introduce an innovative approach for sulfur modification of cobalt phosphide (CoP) using phosphine sulfides (SPR_3) as molecular S-transfer reagents. SPR_3 effectively added sulfur to the surface of CoP, offering control over the quantity and type of sulfur transferred by employing various SPR_3 reagents with differing P=S bond strengths. Their findings reveal diverse sulfur binding sites on the amorphous CoP surface, with binding strengths ranging from 69 to 84 kcal/mol. This fundamental insight sheds light on the interaction of sulfur with CoP and its impact on catalysis. For the catalytic hydrogenation of cinnamaldehyde, an optimal balance was achieved with intermediate sulfur quantities and binding strengths at the CoP surface. This approach enhanced hydrogenation productivity while reducing the formation of secondary reaction products, underscoring the potential for innovative catalyst design.

Authors' comments:

"Our method of modifying CoP with sulfur provides important insight into the site distribution of S on amorphous surfaces and enables the rational design of S-doped catalytic materials."



Light Yield and Thermal Quenching of Ce³⁺ and Pr³⁺ Co-doped LaBr₃:Sm²⁺ Near-infrared Scintillators

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<https://doi.org/10.1016/j.optmat.2023.114375>
 Delft University of Technology and University of Bern

Good energy resolution and high light yield made LaBr₃:Ce one of the best scintillators used for measurements and spectroscopy of high energy radiations. However, its light emission lies in the ultraviolet part of the electromagnetic spectrum, which does not match well with the sensitivity curves of semiconductor-based photodetectors. This leads to a resolution loss due to inefficient light-to-charge conversion. In this work, authors used Sm²⁺ as an activator instead of Ce³⁺. Sm²⁺ doped scintillators showed good light yields with emission maximum lying in the near-infrared part of the electromagnetic spectrum and might be co-doped with either Ce³⁺ or Pr³⁺. These materials could be used as a basis for the development of novel scintillation detectors with higher efficiency and resolution.

Authors' comments:

"The long-standing, very fruitful collaboration between solid state chemistry at U Bern and scintillator research at TU Delft opened the field of rare earth halide scintillators. Patented results were commercialized by Luxium (St. Gobain Crystals & Detectors)."

