

SAYAN KUMAR JANA
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Educational Background

Secondary

Board	West Bengal Board of Secondary Education (WBBSE)
Marks (%)	85.4
Subjects	Bengali, English, Mathematics, Physical Science, Biological Science, History, Geography

Higher Secondary (10+2)

Board	West Bengal Council of Higher Secondary Education (WBCHSE)
Marks (%)	80.6
Subjects	Bengali, English, Chemistry, Physics, Mathematics, Biology

Bsc. in Chemistry (Vidyasagar University)

College	Bajkul Milani Mahavidyalaya
Marks (%)	73.5

Int. PhD

Institute	IISER Kolkata
CGPA (upto 6th sem)	9.5

Teaching Assistantship

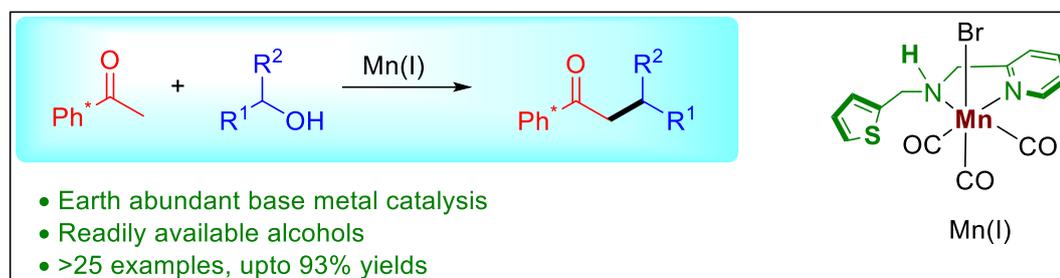
- Teaching Assistant for “CH2203- Synthesis and Characterization Laboratory”- 2 nd Year UG Students
- Teaching Assistant for “CH3104- Physical Organic Chemistry”- 3 rd Year UG Students
- Online Teaching at Jawahar Navodaya Vidyalaya (JNV), Kalyani, Nadia- XIth and XIIth Students

Awards & Achievement:

- SWAMI VIVEKANANDA MCM SCHOLARSHIP (2015-2018)
- JAM 2018
- CSIR-UGC NET (June 2018)
- GATE 2020
- PRIME MINISTER RESEARCH FELLOW (May 2020)

Research Interest:

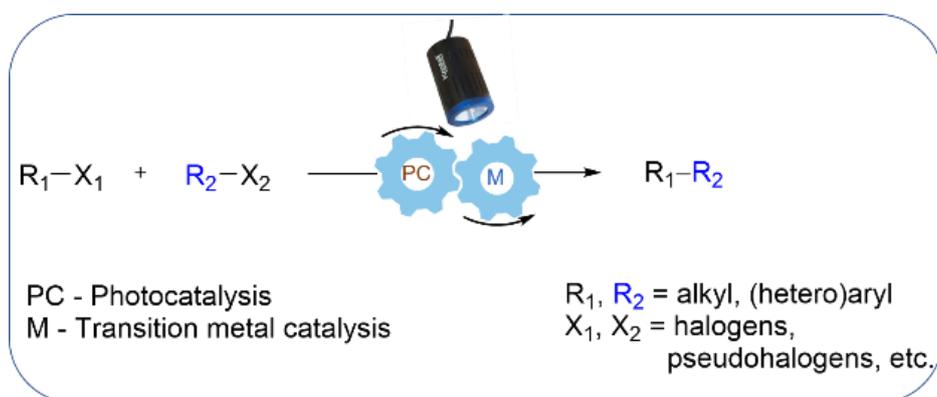
At my early research work I mainly focused on “borrowing hydrogen” (BH) catalysis to construct C-C bond. Here our primary goal was the replacement of precious metals by earth-abundant metals for this type of catalytic transformations. In this regard, lately, well-defined manganese(I) complexes have emerged as an attractive noble metal replacer in sustainable (de)hydrogenation reactions and other organic transformations.



At present I'm working on 'Visible-Light-Mediated C-C Bond Formation Reaction via Transition Metal/Photoredox Dual Catalysis'. Here also the formation of the C-C bond is one of the central goal and photoredox/transition metal catalysis is an alternative to the traditional methods. We wish to use visible light as the sole energy source to drive these reactions. Abundant and less toxic organic reductants will be utilized as the sacrificial reductant. The method will be applied for making C_{sp3}-C_{sp2}, C_{sp2}-C_{sp2}, and C_{sp3}-C_{sp3} bonds and other reductive functionalization reactions. We envisioned that the mildness of the developed protocol would accommodate larger functional groups. It will also enable the synthesis and late-stage functionalization of targeted bioactive molecules. Transition-metal-catalyzed cross-coupling reaction between C-X electrophiles (X = Cl, Br, OTf, etc.) and C-M nucleophiles (M = Mg, Zn, B, Si, Sn) is one of the most powerful tools in organic synthesis. It played a vital role in the preparation of complex medicinal drugs, designing functional ligands, molecular materials, including industrial applications. However, unavailability of the organometallic C-M nucleophiles, their cost, handling issues under ambient conditions, and generation of copious waste demanded an alternative of traditional cross-coupling reaction. In recent years, a conceptually different approach that is the reductive cross-coupling reaction between two electrophiles has emerged. The method utilizes bench-stable high-valent late-transition metal salts (such as Pd, Ni, Co, Fe, Cr) as a catalyst and excess amount metallic terminal reductants (such as Zn, Mn, In, Sm, Mg). Importantly, these protocols avoid the individual preparation of hazardous organometallics reagents and offered wide availability of diverse electrophiles for

coupling. However, the use of an excessive amount of metallic powder as a reductant generates an over-stoichiometric amount of metal salts as waste that not only complicates the work-up and purification procedure but also creates environmental concern over waste disposal. Not only that, reductant-derived metal salts often reduce the catalytic performance of the low-valent catalysts by coordination to the active sites. Additionally, functional group tolerance is not too much due to the presence of an external metal reductant. To overcome these concerns, an alternative catalytic method of activation is in high demand.

Visible light photoredox catalysis has emerged as a powerful arsenal in organic synthesis. It leverages abundant visible light for the bond activation process in a controlled manner without the need for toxic and hazardous reagents. Upon excitation with visible light, a photoredox catalyst can simultaneously act as a powerful oxidant and reductant. We envision that merging photoredox catalysis with transition metal catalysis in a dual-catalysis fashion might address the challenges of the classical cross-coupling reaction and might pave the way for the development of the novel bond formation reactions.



Publication:

- Waiba, S.; Jana, S. K.; Jati, A.; Jana, A.; Maji, B., Manganese complex-catalysed α -alkylation of ketones with secondary alcohols enables the synthesis of β -branched carbonyl compounds. *Chem. Commun.* **2020**, 56 (60), 8376-8379.
- Photoredox/Nickel Dual Catalysis Enables Facile Synthesis of Alkyl Cyclopropanes via $C(sp^3)$ - $C(sp^3)$ Cross Electrophile Coupling of Unactivated Alkyl Electrophiles.
Manuscript under preparation

**Manganese complex-catalysed α -alkylation of ketones with secondary alcohols enables the synthesis of β -branched carbonyl compounds†**

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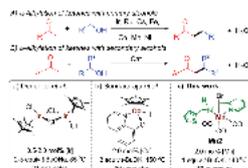
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Herein, β -branched carbonyl compounds were synthesised via the α -alkylation of ketones with secondary alcohols under "borrowing hydrogen" catalysis. A wide range of secondary alcohols, including various cyclic, acyclic, symmetrical, and unsymmetrical alcohols, have been successfully applied under the developed reaction conditions. A manganese complex bearing a phosphine-free multifunctional ligand catalysed the reaction and produced water as the sole byproduct.

The development of catalytic methods for the construction of C-C bonds is one of the central goals in organic synthesis. The delicacy of "borrowing hydrogen" (BH) catalysis lies in the fact that it utilizes alcohol as an alternative carbon source for such processes under eco-friendly conditions avoiding substrate prefunctionalization, organohalides, cryogenic temperature, etc.¹ In this process, alcohols get activated by dehydrogenation for a reaction with a nucleophile, which is then followed by hydrogenation of the resulting unsaturated intermediate by the "borrowed hydrogen", thereby making the whole process atom economical, and benign.

In the recent past, BH catalysis has widely been applied for the α -alkylation of ketones with primary alcohols (Scheme 1A).^{2,3} On the other hand, the use of secondary alcohols under BH catalysis to generate the β -branched ketones molecular architecture is limited (Scheme 1B).² Commonly, the β -branched ketones were made in the presence of lithium bases by using secondary alkyl halide as an electrophile and this unavoidably produced a large amount of waste.⁴ In a pioneering work, Donohoe and coworkers reported the α -alkylation of ketones with secondary alcohols leading to β -branched products using [Cp*IrCl₂]₂ (Cp* = C₅(CH₃)₅) as a catalyst (Scheme 1Ba).^{5,6} The steric factor of the used carbonyl substrate was exploited to limit the self-condensation of the carbonyl substrate used and the ketone,



Scheme 1 Alkylation of ketones.

derived during the reaction from the secondary alcohol.^{5,6,7} The replacement of precious metals by earth-abundant metals for this type of catalytic transformations is highly attractive in terms of toxicity, cost, and sustainability.⁸ In this regard, the only base metal-catalysed reaction of this type was reported by the Sundararaju group using [Cp*Co(N₂O)] [(N₂O) = quinolin-8-olate] as a catalyst (Scheme 1Bb).⁹ However, the recent European Commission's list of critical raw materials (CRMs) suggested that except cobalt, all first-row transition metals exceed the economic importance threshold while their abundance is below the supply risk threshold.⁷ In this regard, lately, well-defined manganese complexes have emerged as an attractive noble metal replacer in sustainable (de)hydrogenation reactions and other organic transformations.⁸ Manganese is the third-most abundant transition metal in the earth's crust (after iron and titanium) and it is less toxic than its higher analogs. Not long ago, selective α -alkylations of ketones was achieved by using Mn(I) catalysis by Beller,¹⁰ Rueping,¹¹ Sortais,¹² and our groups.¹³ Alkylations of esters and amides with primary alcohols were also disclosed under manganese catalysis.¹⁴ We have also reported the alkylations of nitriles using a well-defined phosphine-free manganese complex.¹⁵ However, to the best of our knowledge, manganese complex-catalysed alkylations of methyl ketones with

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Academic background

- Ph.D. (2012). Ludwig-Maximilians-Universität München, Germany. (Supervisor: Prof. Dr. Herbert Mayr,) Grade: Summa cum laude
- M.Sc. (2009). Indian Institute of Technology Kanpur (IIT K), India (M.Sc. thesis supervisor: Prof. Manas. K. Ghorai)
- B.Sc. (2007). Ramakrishna Mission Vidyamandira, University of Calcutta, India

Professional Career

- Associate Professor (Since May 2021) Indian Institute of Science Education and Research (IISER) Kolkata, India

- Assistant Professor (July 2016-May 2021). Indian Institute of Science Education and Research (IISER) Kolkata, India
- Alexander von Humboldt Postdoctoral fellowship (2016) Westfälische Wilhelms-Universität Münster, Germany (Supervisor: Prof. Frank Glorius)
- Postdoctoral Research (2013-2015). Molecular Catalyst Research Center, Japan (Supervisor: Professor Hisashi Yamamoto)

Awards

- 2021: Associate of the Indian Academy of Sciences (IASc)
- 2020: NASI-Young Scientist Platinum Jubilee Award (2020) in Chemical Sciences
- 2019: Thieme Journal Award
- 2017: Early Career Research Award, DST-SERB
- 2016: INSPIRE Faculty Award, DST
- 2015: Alexander von Humboldt Postdoctoral Fellowship
- 2013: "Förderpreis 2013" for best Ph.D. thesis, Ludwig-Maximilians-Universität München
- 2012: Award of the Dr. Klus Römer-Stiftung for Ph.D. students