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Abstract

Aryl and heteroaryl selenides and tellurides are found to have broad applications in the diverse fields such as medicine, biology, materials science, pharmaceutical *etc.* and thus their synthesis remains a challenging field for synthetic chemists in last decade. Although a large no of methodologies have been developed based on metal catalyzed C–Se/Te coupling, a large number of researches has been focused on developing metal catalyst free protocols

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Synthetic strategies for aryl/heterocyclic selenides and tellurides under transition-metal-catalyst free conditions

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Aryl and heteroaryl selenides and tellurides are found to have broad applications in the diverse fields such as medicine, biology, materials science, pharmaceutical *etc.* and thus their synthesis remains a challenging field for synthetic chemists in last decade. Although a large no of methodologies have been developed based on metal catalyzed C–Se/Te coupling, a large number of researches has been focused on developing metal catalyst free protocols due to their sustainability in recent times. This review covers all the recent developments in last decade on their synthesis under metal catalyst free conditions by using different sustainable techniques *e.g.* greener reagents and solvents, ball milling, visible light photocatalysis, microwave, ultrasound *etc.*

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1 Introduction

C–Se/C–Te bond formations for the synthesis of organoselenides and tellurides are getting much attention from organic chemists due to their important applications in biological, environmental and pharmaceutical fields of study.[1] They also have great significance in structural chemistry,[2] materials science[3] and in synthetic chemistry acting as reagents in broad array of synthesis and catalysis.[4] Se and Te based molecules were also found to have interesting applications in semiconductors, magnets and NLO materials.[5] Furthermore the increasing interests in selenium and tellurium chemistry is coming from the recent developments of Se- and Te-based organocatalysts which were found effective in several functional group transformations under sustainable condition for the synthesis of bio-active molecules.[6] Although organotellurides are less explored, organoselenides which are less toxic than selenium, were found to have diverse applications in medicinal and biological fields by showing anticancer, anti-HIV and anti-bacterial activities.[7] Aryl and heteroaryl selenides are found to have large array of applications against several human diseases and thus been applied in human body as potential therapy against them (Fig. 1).[8,9] Among heteroaryl selenides *N*-based heteroaryl selenides such as selenylindoles, selenylimidazo[1,2-*a*]pyridines were found most potential against human diseases due to the biological importance of N-heterocycles.[10–12] Thus developing synthetic methodologies of C–Se bond formations on arenes and heteroarenes has become a research hotspot in recent times. In last two decades transition metal catalyzed cross-coupling reactions have become a powerful tool for the synthesis of aryl/heteroaryl selenides.[13] However, use of expensive and in some cases toxic metal salts, ligands, harsh conditions, high temperature *etc.* were the serious limitations of those protocols.

Beletskaya and Ananikov *et al* summarized transition metal catalyzed C–S, C–Se and C–Te cross-coupling reactions.[13] Lenardao and coworkers highlighted different non-

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Dr Debasish Kundu was born in West Bengal, India and has done his B.Sc. from Visva-Bharati University (University Rank 1) and M.Sc. from IIT Kharagpur (University Rank 1). Dr Kundu has completed his Ph.D. from IACS-Kolkata and received Elli Lilly Asia Outstanding Thesis Award in 2015. Currently he is assistant professor in Government General Degree College at Mangalkote and his research interest is focused on transition metal catalyzed cross coupling and C–H activation. He has published the pioneering research in the field of Ni and Co catalyzed C–O cross coupling. He was the recipient of Marie Skłodowska-Curie Seal of Excellence Award from European council in 2017. He was the visiting scientist in 65th Lindau Nobel Laureate Meeting in Germany and also visited several research institutes in Germany, France, Austria and Switzerland. Dr Kundu has published more than 30 articles in several prestigious national and international journals of ACS, RSC, Wiley, Elsevier.