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Research Paper

Ultrasound assisted Schiff base metal complexes, organic reactions and nano-particles synthesis study -A Review

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ABSTRACT: This review covers ultrasound-assisted organic reactions, Schiff base metal complex using the one-pot synthesis method. A number of Schiff base derivatives series were synthesized employing ultrasonic irradiation. Ultrasound irradiation has allowed the preparation of the target products with the best yields in a very short reaction time. The quality of the product was determined by SEM-TEM, HNMR, CMR etc.all the results regarding sonochemistry has excellent as compared to traditional thermal or reflux methods.The prepared product purities to check by physicochemical as well as a single crystal diffraction experiment. In addition, the physical effect of the medium on the wave is referred to as low power or high-frequency ultrasound. Ultrasound irradiation extensively used in the synthesis of nanoparticles and polymer-supported material. Ultrasound method as an agitator or homogenizer along with photosynthesis of nano complex can be very interesting for industrial applications. In fact, chemical changes during ultrasonic irradiation can also be benefiting many areas of chemical synthesis.

KEYWORDS: Sonochemistry, Ultrasound, One-pot synthesis, Schiff bases

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I. INTRODUCTION

A Schiff base plays an important role in organic compounds in many aspects and they have a wide variety of biological and medicinal properties [1-5]. Schiff bases containing the imine (-C=N-) group, which implies so many chemical and physical properties that enhanced the reaction activity [6-7]. Heterocyclic compounds like pyridine, thiophene, furan, etc possess a wide range of applications which is the main reason of their synthesis. These heterocyclic substituted compounds serve as key templates for the development of numerous important medicines.By using Ultrasound irradiation the synthesis of heterocycles is one of the most important objectives in modern drug discovery [8-10]. The traditional reactions that use strongly acidic conditions, expensive catalyst, high temperatures, long reaction times, incompatibility with other functional groups and unsatisfactory yields have been improved by using ultrasound irradiation [13]. Under ultrasonic irradiation, organic transformations occur in high yield, short reaction times or milder conditions[15, 16]. Therefore, much attention has been paid for the development of new synthetic approaches and new processes [17-20]. In this regard non classical methods like ultrasonic irradiation, microwave-assisted synthesis and supercritical fluids have attracted the attention of chemists to achieve these targets [21-24]. Green chemistry techniques like microwave and ultrasound-mediated organic synthesis have become increasingly used techniques for the production of the new molecule that has attracted in many areas, especially in the field of synthetic organic chemistry. Ultrasonic irradiation is a powerful technique in chemical processes and synthesis of Schiff base metal complex and much organic synthesis, because it can be applied to many chemical reactions with outstanding results [4-6]. Ultra sonication can bring various benefits, such as environmental friendliness, power saving (no toxic chemicals are used or produced), cost-efficiency, compact in nature, solvent-free [10].

II. ULTRASOUND ASSISTED SCHIFF BASE METAL COMPLEX SYNTHESIS

Ayman El-Faham,SaiedM. Soliman *et.al* were synthesized the (2-chloro-4,6-dipieridino/dimorpholino),4-(4-Chloro-6-(piperidin-1-yl)-1,3,5-triazin-2-yl)morpholine, 2-chloro-4-methoxy-6-piperidino-/or morpholino-1,3,5-triazine they have predicted in this research article that Ultrasonic irradiation

assisted the synthesis of a novel series of 4,6-disubstituted-s-triazine-Schiff base derivatives. The predicted that Ultra sonication affords the product higher yield and purity than conventional heating. The synthesized product they were used for Biological screening (MTT-ASSAY), DFT studies, atomic change distribution, reactivity study, and anti-proliferative effects [11].

Khalid M. Khan, WaqasJamil et.al was studied the expeditious the synthetic approach towards the synthesis of bis-Schiffbases (aldazines) using ultrasound ultrasonic mediated reactions were carried out in Clifton Ultrasonic Bath (2×T2A, 300 W, DU-4) made by NickelElectro Ltd, by using this ultrasonic instrument they were prepared24 aldehyde derivatives with hydrazine hydrate and synthesis of those product timing compared with the conventional method they got surprisingly results in all the above said derivatives prepared within the 1to2 mines instead of 1to 2 hrs. The synthesized product was confirmed by IR, ^{1}HNMR, Mass, etc.[12].

The review article of Ultrasound-assisted green synthesis of five-membered *O*- and *S*-heterocycles compounds by NavjeetKaur, He was studied total of 39 schemes of heterocyclic compounds like Synthesis of 2,5-dihydro-5-imino-2-methyl furan-3,4-dicarboxylate, Synthesis of 3-(2-benzofuroyl)carbazoles, Synthesis of (9-methyl-9H-carbazole-3,6-diyl)bis(benzofuran-2-yl-methanone)s. Synthesis of 3-(2-naphtho[2,1-b]furoyl)-N-ethyl-9H-carbazole and 3,6-bis(2-naphtho[2,1-b]furoyl)-N-ethyl-9H-carbazole, 3-oxazoline. After studying the 36 schemes He were predicted that Ultrasonic-assisted technique is used more and more to accelerate organic reactions as a green synthetic approach [13].

ZohrehParsaee, PouyaHaratipour et.al, were synthesized a novel diphenyl based Schiff base (H2L)*2,2'((1E,1'E)(((hexylazanediyl)bis(4,1phenylene))bis(methanylylidene))bis(azanylylidene))bis(4-methylphenol)* was synthesized in nano-sized using sonochemistry method and it was characterized by FT-IR, MS, TGA, ^{1}HNMR, ^{13}CNMR, SEM and elemental analysis technique. They were successful to find the H2Lapplications as a chemo sensor showed the color change from yellow to pink in presence of copper (II) ion in aqueous media due to binging of H2L and Cu (II). high selectivity toward Cu^{2+} over competitor cations by color change yellow to pink that can be explained by the formation of a binuclear copper complex (Cu_2L_2)[14].

M. Bharathi, S. Indiraet.al was developed the recoverable catalysts by covalentlyattaching complexes such as Cu-complex-phen and Cu-complexity by using the greener pathway that is sonochemistry. The general procedure regarding to synthesis of Schiff base and metal complex were given and obtaining product was confirmed by SEM-EDX, HNMR and other novel techniques. They were succeeded in catalytic functioning of Cu-comperlexphen- MCM-41 (C1) and Cu-complex-bipy-MCM-41 (C2) to enhance the yield up to 95%and also recovered catalyst very easily and reused catalyst three times repeatedly in reactions[15-16].

The Baeyer-Villiger oxidation is an important reaction route in the synthesized of esters and lactones which are common synthetic intermediates with significance on the production Of high-value chemicals, therefore Luisa M. D., R. S. Martins *et.al* was synthesized the Schiff base 2-[(2, 3-dihydroxy phenyl)methylideneamino]benzenesulfonic acid (H3L) are Despite having the mono-protonated dianionic ligand (HL2–) behaves as O,O,O-tridentate chelator. synthesized a new dimethyltin(IV) based coordination polymer, [SnMe2(HL)(CH3OH)]n(0.5nCH3OH) utilizing as pro-ligand the multidentate Schiff base .in this research paper they studied 35 schemes of oxidations of alcohols and concluded that microwave and sonochemical procedures are important steps towards the enhancement of green chemical methods to Synthesize esters and lactones.Single crystal X-ray diffraction study reveals coordination polymer with every tin(IV) ions bound to two methyl groups, a methanol that molecule, two Ophenoxo and one μ-Osulfonate atoms from HL_2. The coordination polymer 1 was applied as heterogeneous catalyst for the Baeyer-Villiger oxidation of ketones to esters or lactones, using aqueous hydrogen peroxide as oxidant, under ultrasound (US) or microwave [17].

KhadijehRabieiet.al was used Schiff base in presence of Mg/CCl_4 and reported gem-dichloroaziridine derivatives under ultrasonic irradiation. In this research paper the researcher were concluded that the, the desired products were purely obtained in excellent yields. They were reported 12 derivatives by using the R_1 = H, CH_3, NO_2, Cl andR_2 = H, CH_3, Cl, Br as the following reaction scheme given here .reaction completion was studied by ^{1}HNMR, Mass etc.

Figure1: Preparation of Schiff base in presence of Mg/CCl_4

Schiff base derivatives not only synthesized by sonochemical methods but also several numbers of techniques were used as conventional, microwave irradiation and protractor but many researcher reported the sonochemical is one of the best innovative method in the area of Schiff base and there complex synthesis. ArifMermer,NeslihanDemirbaset.al was reported the Schiff base and their derivatives synthesized from 4-methyl aniline (1mmol), 4-nitrobenzaldehyde (E)-2-((p-tolylimino)methyl)phenol, (E)-N-(4-methoxybenzylidene)-4-methylaniline (1b) E)-N-(4-fluorobenzylidene)-4-methylaniline (1c), (E)-4-Methyl-N-(4-nitrobenzylidene)aniline (1d) (E)-N-(2,4-dichlorobenzylidene)-4-methylaniline (1e), (E)-N-(2,6-dichlorobenzylidene)-4-methylaniline (1f) E)-N-(2-chloro-6-fluorobenzylidene)-4-methylaniline (1g), E)-4-Methyl-N-(pyridin-3-ylmethylene)aniline (1h), (E)-4-Methyl-N-(pyridin-4-ylmethylene)aniline (1i)etc upto19 derivatives from the formaldehyde and substituted aniline synthesized and confirmed by HNMR,CMR,IR etc. they were also studied the time, yield quality of the product and concluded the best results for ultrasound synthesis[19].

V.S.V.Satyanarayanaa, et.alwere studied that, the Imidazole moiety is an important member of the five-membered heterocyclic ring, which is widely present in so many naturally occurring organic molecules amongst those many of the substituted imidazoles and 2-thioimidazoles having fungicidal, herbicidal, anti-asthmatic, and anti-inflammatory properties possessed. In this research paper, they have been synthesized a series of novel Schiff base derivatives incorporating 2,4,5- triphenyl-1*H*-imidazole moiety has been synthesized under reflux conditions/ultrasonic irradiation. They were concluded that the Sonochemical synthesis under the irradiation of ultrasound in solution is an effective method in a large number of organic reactions which can be carried out in higher yields, shorter reaction time, and milder conditions, as compared with the conventional methods. They also concluded that this technique was controllable and effective in synthesis [20].

III. ULTRASOUND ASSISTED SOME NANO-COMPOSITES SYNTHESIS REACTIONS

Maryam Ghiyasiyan-Arani, MasoudSalavati-Niasari et.al was presented the research work on a new approach to Schiff-base ligand assisted sonochemical synthesis of iron vanadate nano-composite. In this work, they were tried to comparing various factors and reaction conditions such as morphology, size, and uniformity of as-obtained samples. In this work, a Schiff-base capping agent (Bis(acetylacetone) ethylenediamine-H_2acacen) was used and observed via in-situ ultrasound-assisted procedure by using NH4F in one step and observed the influence of different parameters such as type of dye and light source on the photocatalytic ability of samples were studied. Sonochemical synthesis of iron vanadate sphere-like nanoparticle was carried out by using the following procedure in which they took the 0.25 g iron(III) nitrate nonahydrate and 0.138 g H_2acacen (Fe: H_2acacen = 1:1) dissolved in distilled water and slowly added to each other. A solution containing the metal and the ligand (solution A) is mixed by a stirrer for 5 minutes. Then 0.072 g ammonium metavanadate dissolved in distilled water 70°C (solution B). Finally, solution B was added to solution A under ultrasound irradiation (solution C). To prevent the formation of byproducts, pH adjusted on 5. After irradiation, Iron vanadate powder was obtained. The synthesized powder was subjected to XRD, FT-IR, EDS, SEM, and TEM study to determine the purity and structural morphology of the compound. They were succeeded in the synthesis of nano-size $FeVO_4$ and $FeVO_4/V_2O_5$ by using ultrasound irradiation[21].

Calcium has been a great application in every biological metabolism. Amorphous calcium phosphate (ACP) has useful potential in the biomaterials field due to its non-cytotoxicity,high bioactivity, and good cyto-compatibility. Kun He, Gui-Yong Xiao *et.al* has prepared the ACP by using ultrasonic irradiation. In this research paper, they followed the following procedure that the solvent of $Ca(NO_3)_2.4H_2O$ was ethanol and the

solvent of $(NH_4)_2HPO_4$ was a mixture of water and ethanol, under ultrasonic the product was studied by HRTEM and XRD. The pathway of the synthesized product was shown as follows.

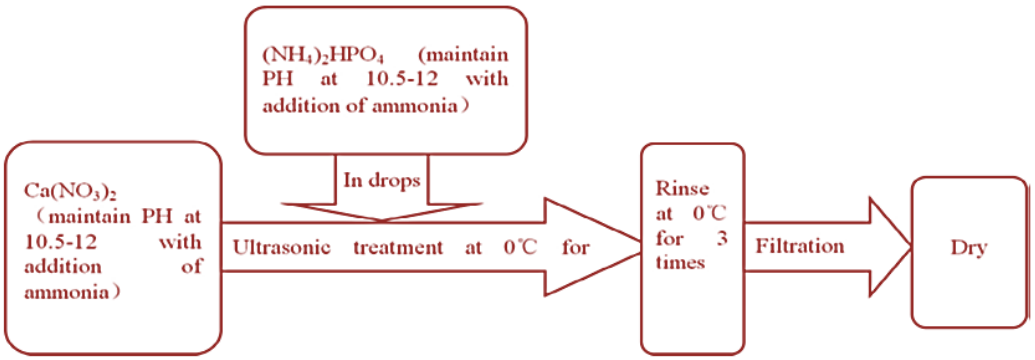

Figure 2: Preparation of ACP by using ultrasonic irradiation

In this research work they predicted that Ultrasonic obviously enhanced amorphization during the synthesis of calcium phosphate and also enhanced the reaction rate and it one of the most facile methods [23]. The K.J. Jarag , D.V. Pinjariet.almade to synthesize chalcone (3-(4-fluorophenyl)-1-(4-methoxyphenyl)-prop-2-en-1-one) by condensation of 4-fluorobenzaldehyde with 1-(4-methoxyphenyl)ethanone under basic conditions by using both conventional (NUS) and sonochemical (US) methods. The reaction scheme of this reaction is as follows;

Figure 3: Synthesis of (3-(4-fluorophenyl)-1-(4-methoxyphenyl)-prop-2-en-1-one)

The same reaction was carried out in basic media with fourhrs. heating in conventional method. The synthesized chalcone [24] derivative by sonochemical method was characterize for FTIR, NMR, and elemental analyses and studied for XRD, PSM, TGA and SEM properties to evaluate its performance obtained under ultrasonic energy and it was observed that complete conversion to chalcone occurred in 10 min by sonochemical method [25]. Balvant S.Singh, Hyacintha R.Lobo et.al was studied on novel oxazole compounds by using effective combination of ultrasound (US) and deep eutectic solvent (DES). The oxazole derivatives have attracted chemical and biological properties like antibacterial, anti-fungal and anti-inflammatory activities. It also has been used as precursors in so many important organic reactions. In conclusion they were predicted that explored for the first time, a unique

Combination of deep eutectic solvent and ultrasonic radiation for clean, ecofriendly,coast effective and efficient synthesis of oxazole derivatives [26].Hongfei Liu, ShengfuJi, and co-workers studied various types of magnetic mesoporous silica nanocomposites for the CTAB-templating synthesis of monodisperse core-shell typemeso-SiO_2@Fe_3O_4 microspheres with a favorable mesoporous silica shell. In this research work, they compared ultrasonic irradiation with the conventional synthetic method and they observed that sonication is one of the simplest coating procedures from two steps to only one step and greatly shorten coating period of mesoporous silica shell from 12-24 hrs to 40 min.

After completion of work, they also conclude that the ultrasound plays the acceleration role during the whole coating process of mesoporous silica shell, including hydrolysis-condensation of TEOS, co-assembly of hydrolyzed precursors and CTAB, and deposition of silica oligomers. And ultrasonically forced oscillations of

the cavitation bubble is favorable for improving the homogeneity of the silica shell and the mono-dispersity of meso-SiO_2@Fe_3O_4 microspheres [27].

IV. RESULT AND DISCUSSION

On this basis the authors are concluded that the ultrasound method is not only applicable for the synthesis of organic compounds but also useful in many different types of chemical practices like polymerization, synthesis in nano particles, surface modification of core nanoparticles and degradations of dyes. This technique is less laborious time saving and economic.

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