List of abbreviations/acronym/symbols used

AAS Atomic Absorption Spectroscopy
BET Brunauer, Emmett and Teller

EDX Energy Dispersive X-ray

EG Ethylene Glycol

FESEM Field Emission Scanning Electron Microscopy

FT-IR Fourier Transform-Infra Red

HRTEM High Resolution Transmission Electron Microscope

ISE Ion Selective Electrode

i-PrOH Isopropanol

JCPDS Joint Committee on Powder Diffraction Studies

KV Kilovolt MeOH Methanol

NMR Nuclear Magnetic Resonance

NOSE Nanoparticle-Catalysed Organic Synthesis Enhancement

NP Nanoparticle

PEG Polyethelyne Glycol

RMSE Root Mean Square Error

SAED Selected Area Electron Diffraction

SEM Scanning Electron Microscopy
SAXS Small Angle X-ray Scattering

USEPA United States Environmental Protection Agency

W Watt

WHO World Health Organization

XRD X-Ray Diffraction ZPC Zero Point Charge

Å Armstrong

As(III) Arsenic(III) species
As(V) Arsenic(V) species
°C Degree Celsius

GHz Gigahertz

h Hour L Litre

Microgram μg Microlitre μL μm Micrometer Miligram mg Milliliter mLmin Minute $\, mV \,$ Millivolt MW Mega-Watt Nanometer nm

s Second t Time

Bragg's angle

2θ

 $\begin{array}{ccc} \lambda & & Wavelength \\ wt & & Weight \\ \% & & Percentage \end{array}$

LIST OF TABLES

- Table 3.1: Optimization of the reaction condition for solvent, time and base
- Table 3.2: Optimization of reaction condition for the catalyst
- Table 3.3: CuO NPs catalysed aerobic homocoupling reaction of arylboronic acids
- Table 4.1: Hetero-coupling reaction under thermal reflux condition
- Table 4.2: Optimization of the reaction condition for microwave oven power, time and base
- Table 4.3: Optimization of reaction condition for the catalyst, base and solvent
- Table 4.4: Pd NPs catalysed aerobic cross-coupling reaction of arylboronic acids
- Table 4.5: Sheldon test
- Table 5.1: Optimization of the reaction condition for solvent and time
- Table 5.2: Azobenzene formation from nitrobenzene varying different bases
- Table 5.3: Optimization of reaction condition varying catalyst amount
- Table 5.4: Optimization of reaction condition varying reaction temperature
- Table 5.5: Azobenzene formation from nitrobenzene with diversely substituted nitrobenzene
- Table 5.6: Hydrogenation and oxidation of azobenzene
- Table 5.7: Sheldon test
- Table 6.1: Pseudo-first order and pseudo-second order kinetic parameters for two different initial arsenic concentrations (C_0)
- Table 6.2: Characteristic parameters of different Isotherm models for the adsorption of arsenic by Iron Oxide Hydroxide nanoflower
- Table 6.3: Regeneration study (adsorbent dosage: 1 gL⁻¹)
- Table 7.1: Thermodynamic parameters for lead adsorption on CuO nanorods
- Table 7.2: Regeneration study (adsorbent dosage: 1 gL⁻¹)

LIST OF FIGURES

- Figure 1.1: Surface atoms distribution vs palladium cluster diameter
- Figure 3.1: TEM image of CuO NPs
- Figure 3.2: SEM image of CuO NPs
- Figure 3.3: EDAX pattern of CuO NPs
- Figure 3.4: Comparison of catalytic performance of CuO NPs vs CuO bulk counterpart
- Figure 3.5: Hot filtration test
- Figure 3.6: Powder XRD patterns of fresh and reused CuO catalyst
- Figure 4.1: Powder XRD pattern of fresh Pd NPs catalyst
- Figure 4.2: HRTEM image of Pd NPs
- Figure 4.3(a): SEM image of Pd NPs before reaction
- Figure 4.3(b): SEM image of Pd NPs after reaction
- Figure 4.4: Particle size distribution of Pd NPs
- Figure 4.5: Comparison of catalytic performance of Pd NPs vs bulk Pd counterpart
- Figure 4.6: Reusability of Pd NPs catalyst
- Figure 5.1: TEM image of CuO NPs
- Figure 5.2: SEM image of CuO NPs
- Figure 5.3: EDAX pattern of CuO NPs
- Figure 5.4: Time conversion plot for nitrobenzene reduction using CuO NPs
- Figure 5.5: Reusability of CuO NPs catalyst
- Figure 5.6: Powder XRD patterns of fresh and reused CuO NPs catalyst
- Figure 6.1(a): TEM image of IOH NPs
- Figure 6.1(b): SAED pattern of IOH NPs
- Figure 6.2: FESEM image of IOH NPs before (a) & after (b) adsorption of arsenic
- Figure 6.3: EDX pattern of IOH nanoflower before (a) and after (b) adsorption of arsenic
- Figure 6.4: FT-IR spectra of IOH nanoflower before (a) and after (b) adsorption of arsenic
- Figure 6.5: Plot of final pH vs initial pH
- Figure 6.6: Plot of Arsenic removal (%) vs agitation time

LIST OF FIGURES CONTD...

- Figure 6.7: Plot of arsenic removal (%) vs adsorbent dose
- Figure 6.8: Effect of initial arsenic concentration on arsenic removal
- Figure 6.9: Effect of pH on the percentage adsorption of arsenic
- Figure 6.10: Plausible mechanism of arsenic adsorption
- Figure 6.11: Effect of agitation speed on removal of arsenic
- Figure 6.12: Effect of competing anions on removal of arsenic
- Figure 6.13: K₁ kinetics, pseudo-first order plots
- Figure 6.14: K₂ kinetics, pseudo-second order plots
- Figure 6.15: The amount of arsenic adsorbed (q_t) vs the square root of time $(t^{0.5})$
- Figure 6.16: Equilibrium isotherm model for arsenic adsorption
- Figure 7.1: XRD pattern of copper oxide NPs
- Figure 7.2(a): TEM and SAED images of copper(II) oxide NPs
- Figure 7.2(b): HRTEM image of copper(II) oxide NPs
- Figure 7.3: FESEM images of CuO NPs before (a) and after (b) adsorption of lead
- Figure 7.4: EDX pattern of Copper Oxide NPs after adsorption of lead
- Figure 7.5: Pore volume distribution vs average pore diameter
- Figure 7.6: FT-IR spectrum of copper oxide NPs
- Figure 7.7: Variation of adsorbent dose on the removal of lead
- Figure 7.8: Removal of lead vs contact time of agitation
- Figure 7.9: Variation of initial conc. of lead on the removal of lead
- Figure 7.10: Removal of lead vs initial pH of the working solution
- Figure 7.11: Plot of Log K_d vs initial pH of lead solution
- Figure 7.12: Plot of final pH vs initial pH of lead solution
- Figure 7.13: Effect of competing ions on removal of lead
- Figure 7.14: Equilibrium isotherm model for lead adsorption

LIST OF SCHEMES

- Scheme 3.1: Model reaction for the synthesis of biphenyls
- Scheme 3.2: General representative scheme for the synthesis of biphenyls
- Scheme 3.3: Plausible mechanism of homocoupling reaction
- Scheme 4.1: Palladium-catalyzed Suzuki-Miyaura cross-couplings of sulfonyl chlorides and boronic Acids
- Scheme 4.2: Model reaction for the synthesis of cross biphenyls
- Scheme 4.3: General representative scheme for the synthesis of cross biphenyls
- Scheme 4.4: Plausible mechanism of cross-coupling reaction
- Scheme 5.1: Model reaction for the formation of azobenzene
- Scheme 5.2: General representative scheme for synthesis of azobenzene
- Scheme 5.3: Products profile of reduction of nitrobenzene
- Scheme 5.4: Plausible mechanism of the reaction