

Valorization of saccharide fractions of biomass and transformations of bio-sourced furan-based platform molecules



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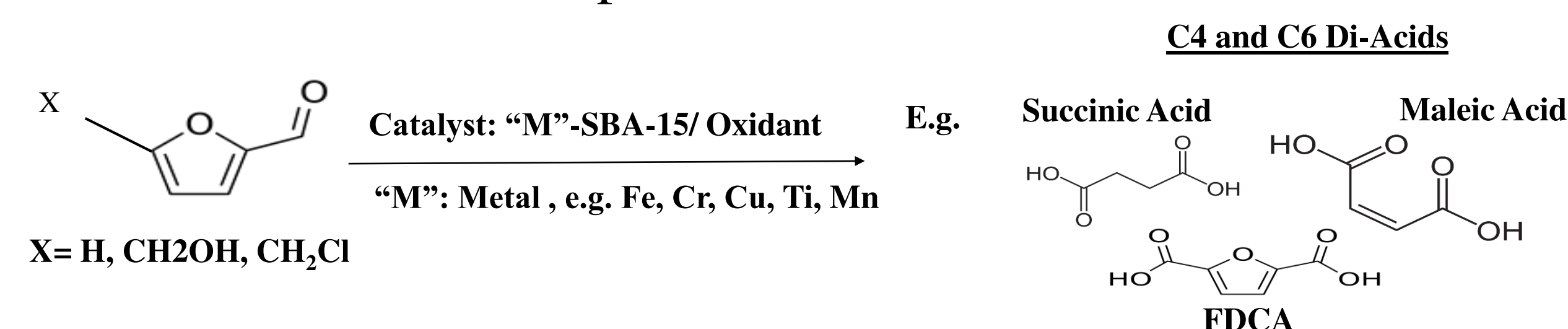
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Introduction & Objective

Materials with distinctive characteristics could be achieved through developing novel varieties of monomers that feature multiple acid or alcohol groups, initially emerging from the fundamental functionality of biomass and biomass-derived compounds. For instance, furfural and hydroxymethylfurfural (HMF) have been recognized as highly

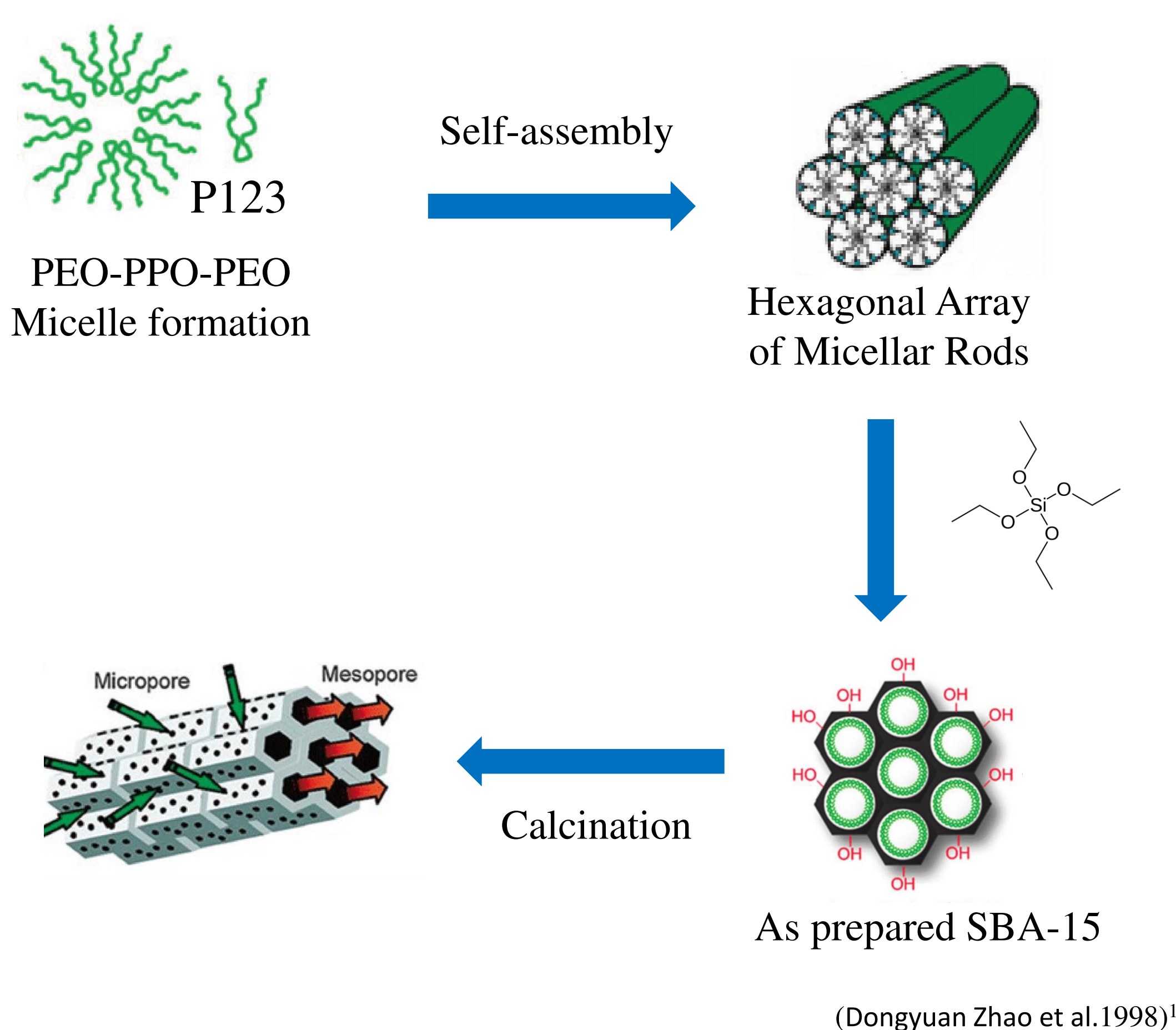
important biomass-derived platform chemicals driven by their diverse functional groups and the simplicity of manufacture from cellulose/hemicellulose through hydrolysis and dehydration, whereby via heterogeneous catalysis, numerous monomers could be generated from the aforementioned platform molecules.

Objective: Employing Nanocomposites of Non-Noble Metal Doped Ordered Silica Matrix for the oxidation of bio-sourced Furan-based platform molecules (Furfural, HMF)

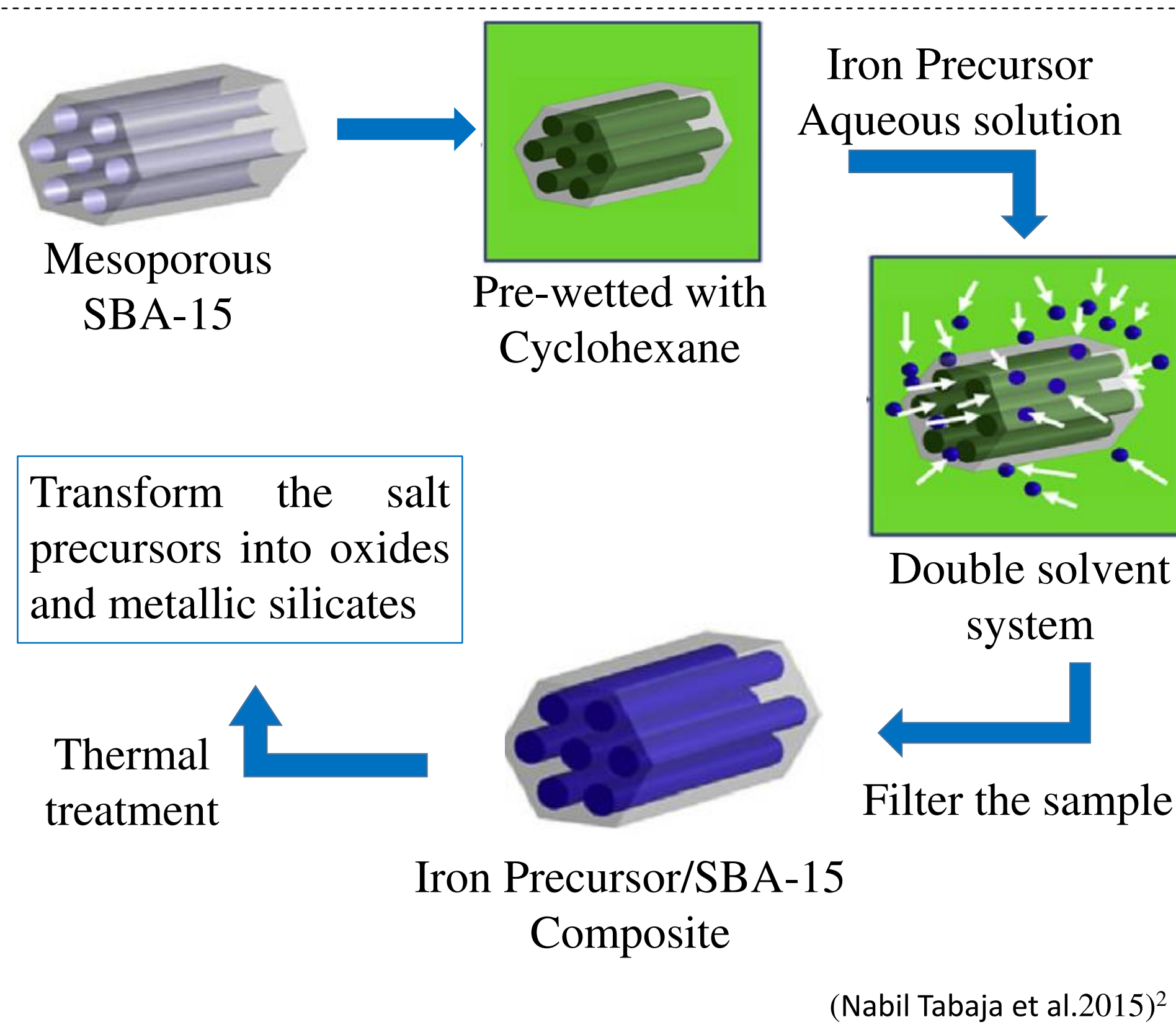


Materials & Methods

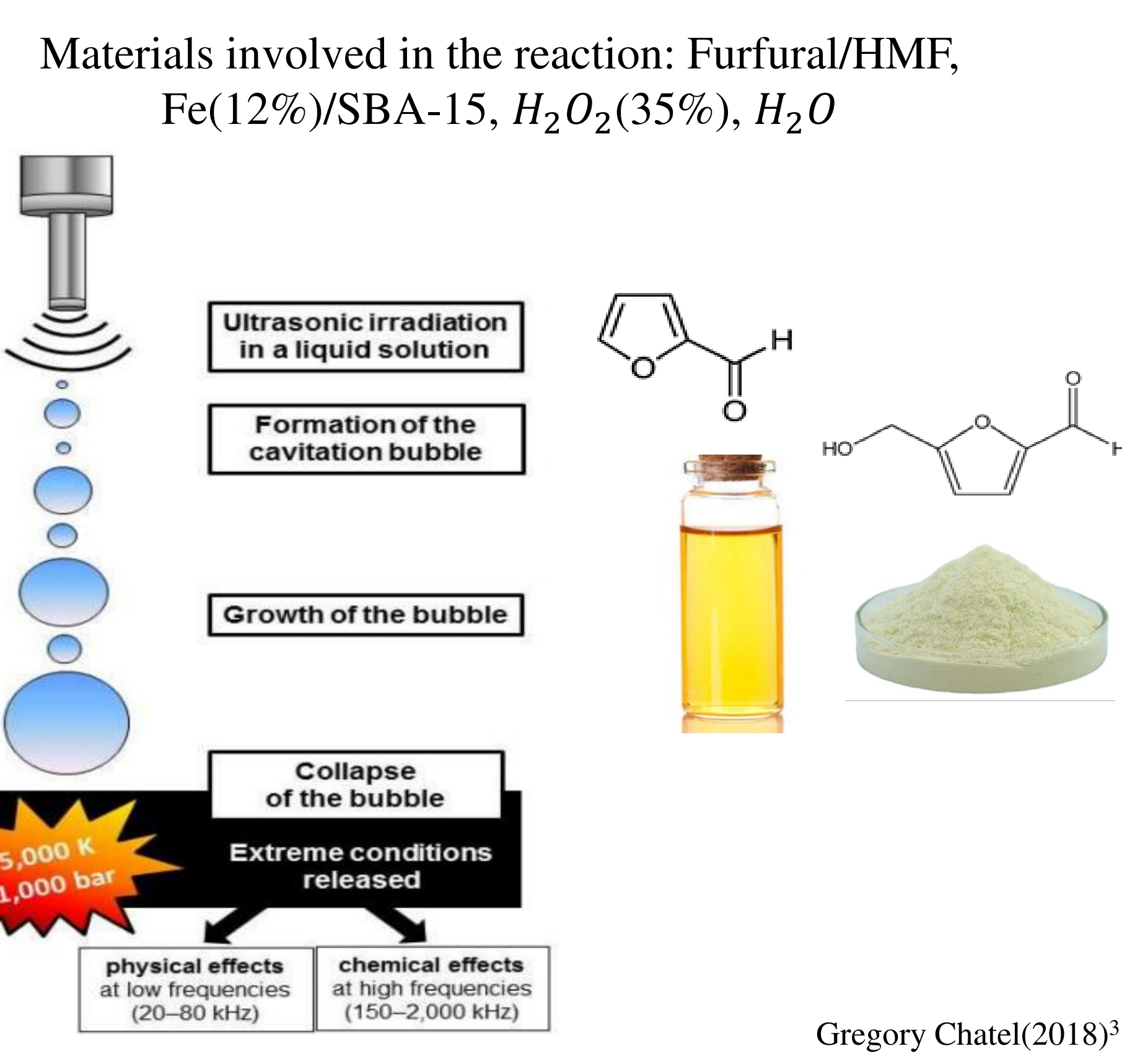
I-SBA-15 implementation



II-Preparation of Fe (12%)-SBA-15 catalyst through grafting by the "Double Solvent method"



III- Catalytic Tests For Oxidation of Furfural and HMF in HFUS (565KHz)



Results & Discussion

Catalyst Characterization

X-Ray diffraction Pattern:

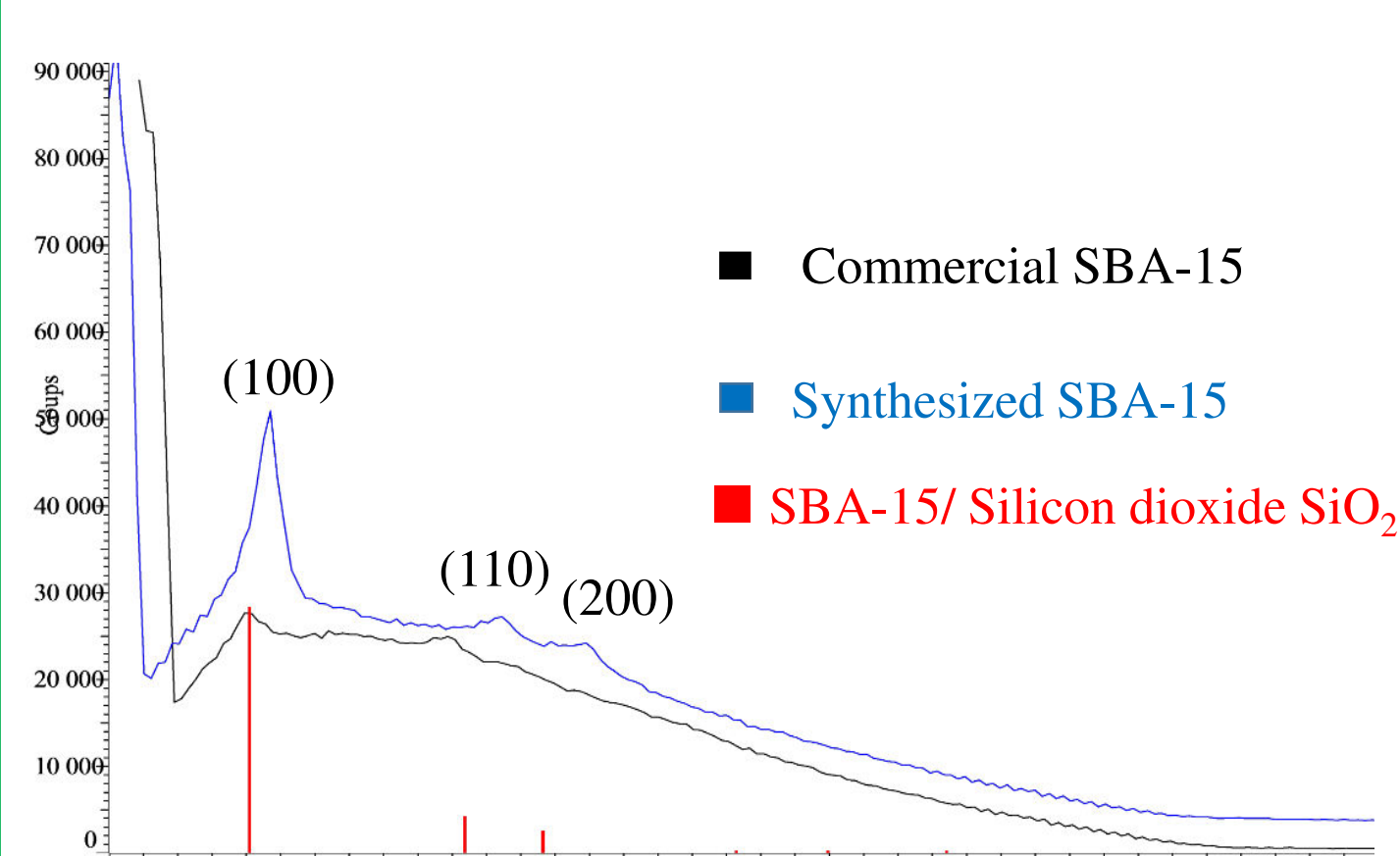
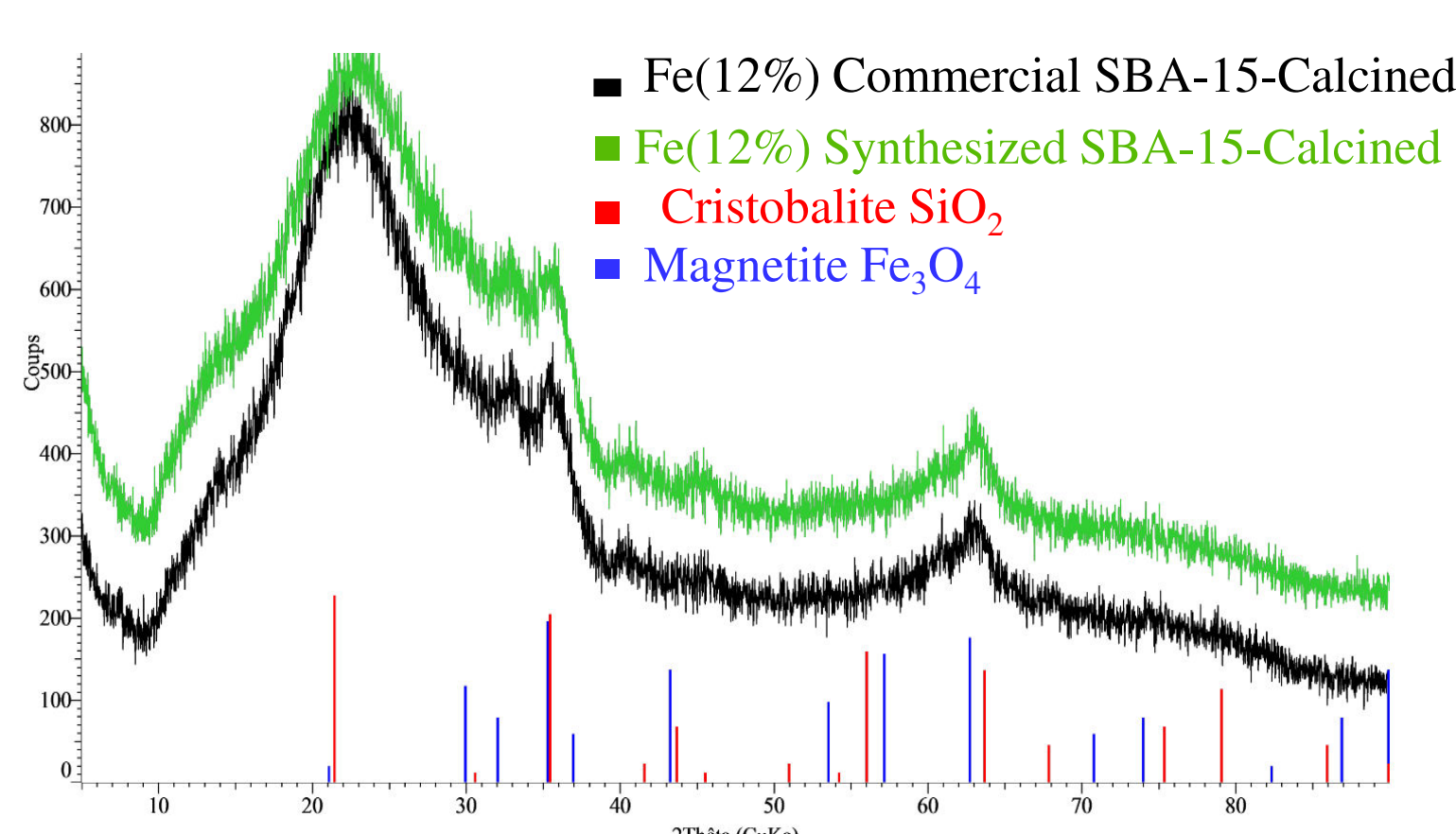
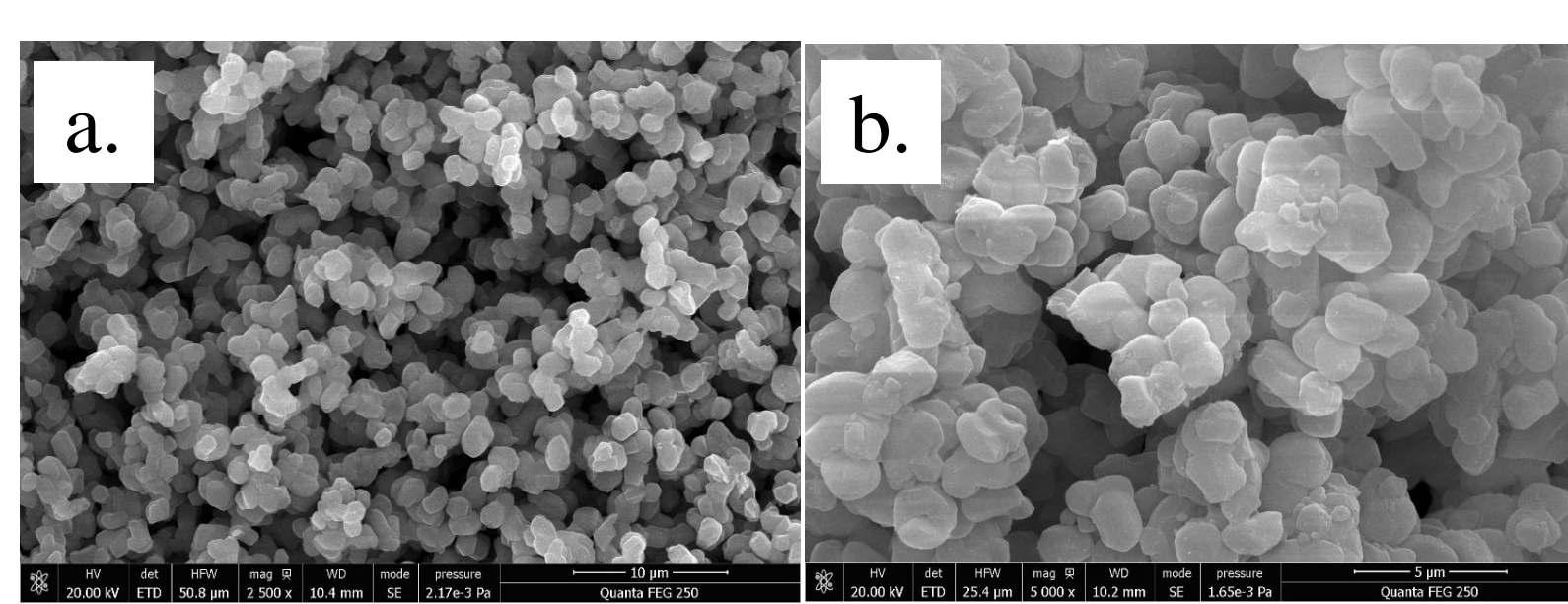
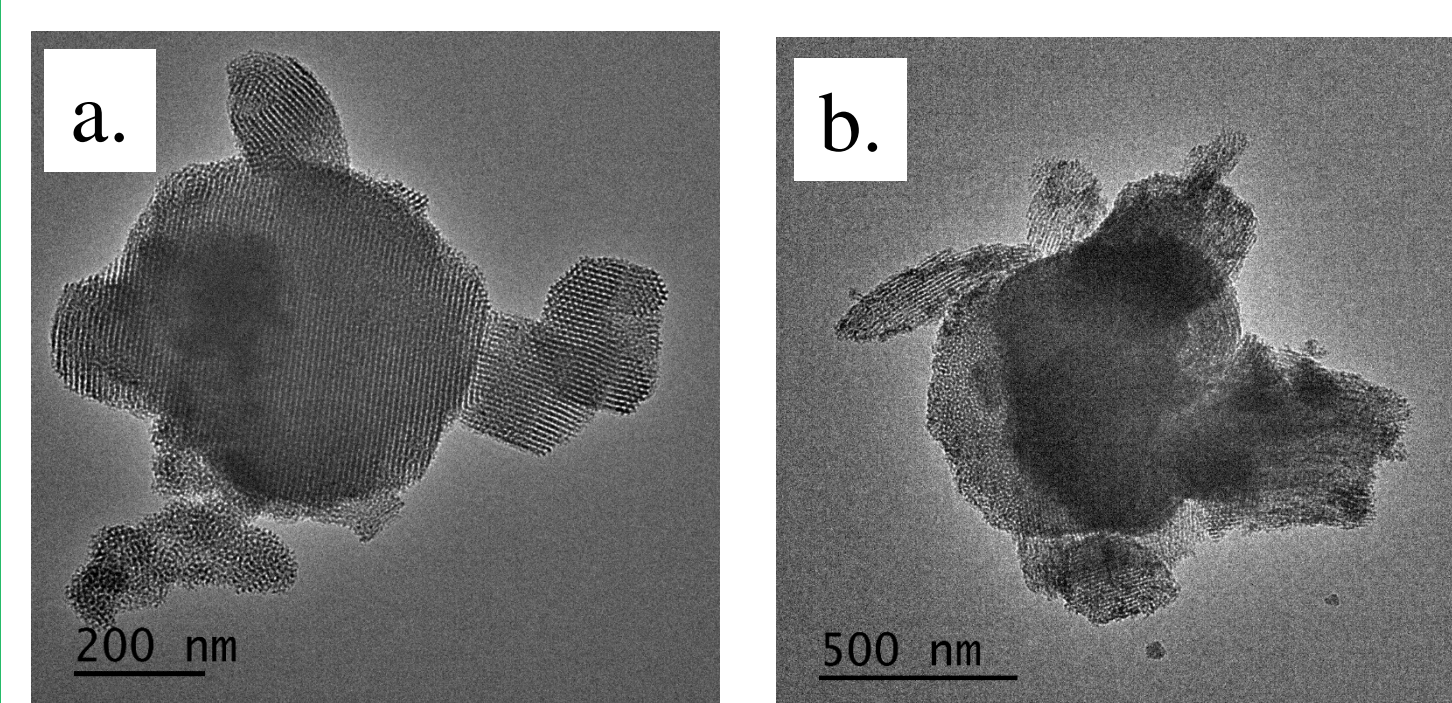


Fig 1 demonstrates the characteristic peaks of SBA-15 that is correlated with the hexagonal structure of SBA-15 that is analogous to the one prepared employing TEOS as the silica source; Fig 2. reveals that iron-oxide is mainly magnetite (Fe₃O₄)



TEM/SEM



(a) Reveals defined channels and hexagonal porous structure
 (b) Good defined channels with a dot-like black particles between the mesoporous channels linked to Fe NPs

(a) Grain-like morphology of the synthesized SBA-15 with length (1-1.4μm) with fairly uniform average size
 (b) Grain-like morphology with detected external NPs of iron-oxide on the surface of SBA-15

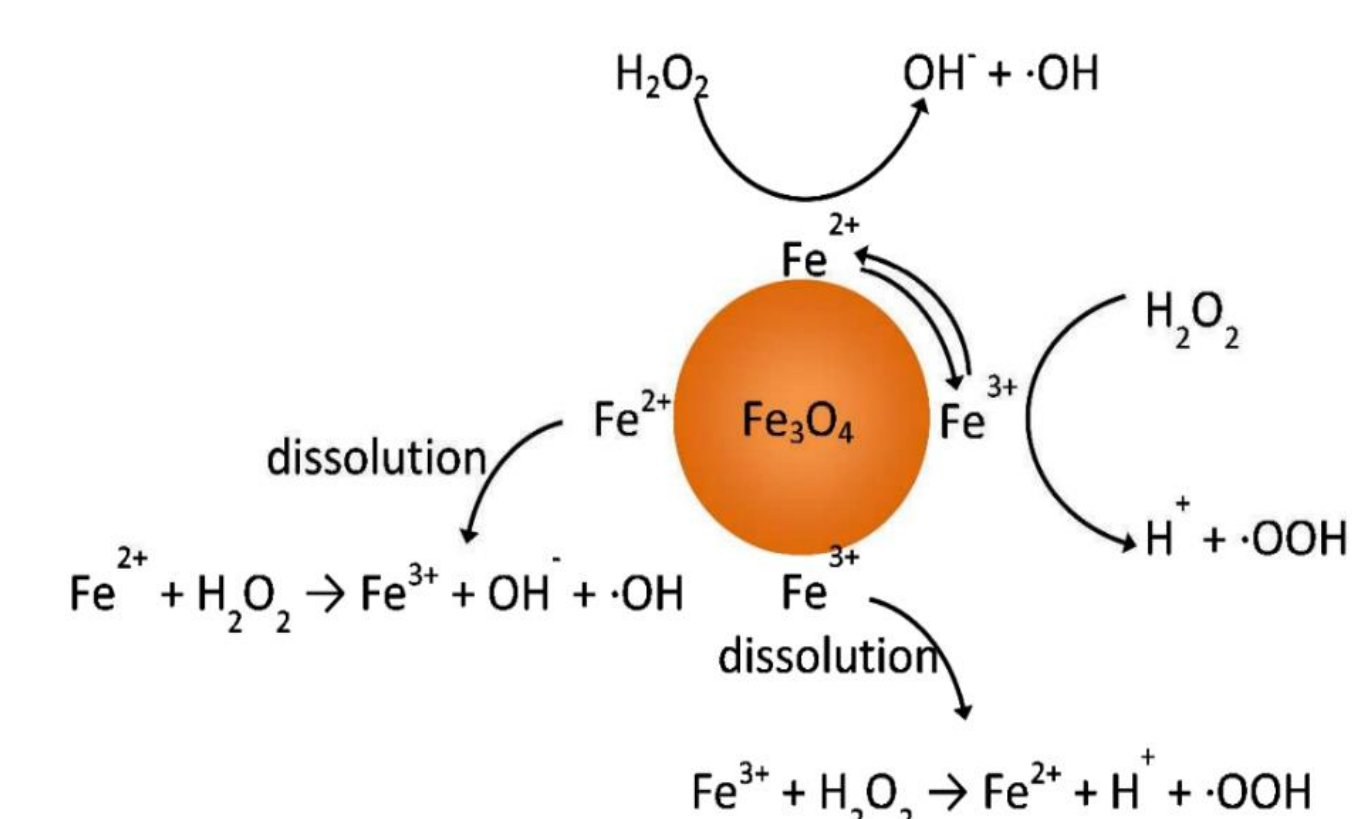
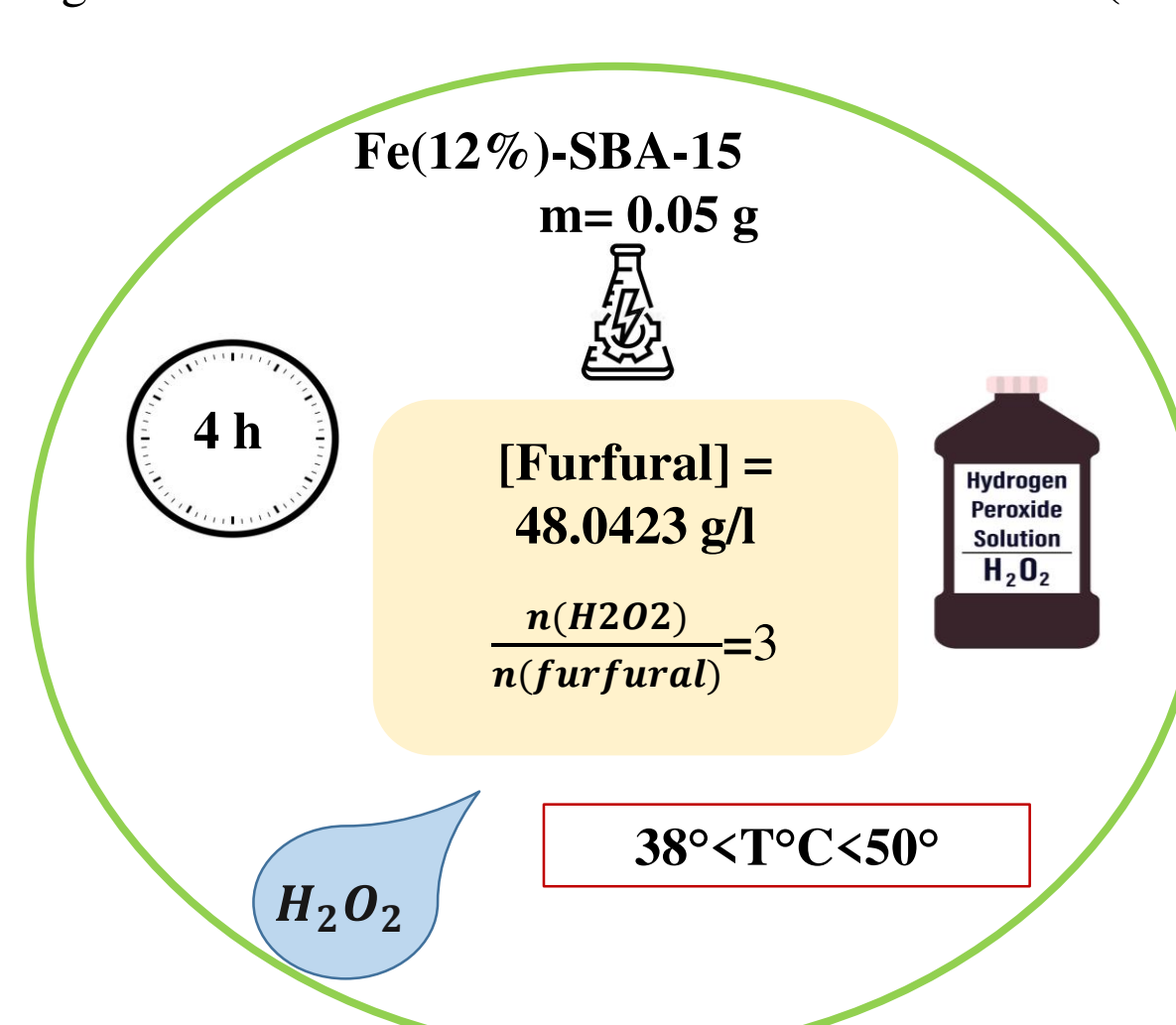
Catalytic Performance on Reaction under study

Table 1 : HMF oxidation conditions with HFUS(565KHz)

HMF: [C]= (2.4g/L)
Catalyst: Fe(12%)-SBA-15 (m=50mg)
H ₂ O
H ₂ O ₂ (30%) in excess
48<T°C<55
Time of reaction: 4h

- Total conversion in the presence of the catalyst
- Low conversion in the absence of the catalyst

Fig 5: Furfural oxidation conditions with HFUS (565KHz)



- Total conversion
- No selectivity
- Products detected:(Hydroxyfuranone, Malonic acid, Malic acid, Maleic acid, Succinic acid, Formic acid)

References

- [1] Dongyuan Zhao et al. Science 279, 548 (1998).
- [2] Nabil Tabaja et al. C.R.Chimie (2015) 358-367.
- [3] Gregory Chatel, Current Opinion in Green and Sustainable Chemistry (2018)

Conclusion & Perspectives

✓ Fe(12%)/SBA-15 with HFUS (565KHz) showed total conversion for both HMF and furfural, but with production of diversity of products with no preferential selectivity, Furfural oxidation (Hydroxyfuranone, Malonic acid, Malic acid, Maleic acid, Succinic acid, Formic acid), HMF (Maleic acid, 5-Hydroxymethyl-2- furancarboxylic acid, Fumaric acid, reaction intermediates).

Perspectives:

- Continue to find and prepare supported metal NPs catalysts e.g. (Ti/SBA-15, Fe-Mn/SBA-15).
- Evaluate all prepared catalysts and test with diverse oxidizing agents.