The Hydrothermal Synthesis of 1D Biomedical Hydroxyapatite Nanostructures

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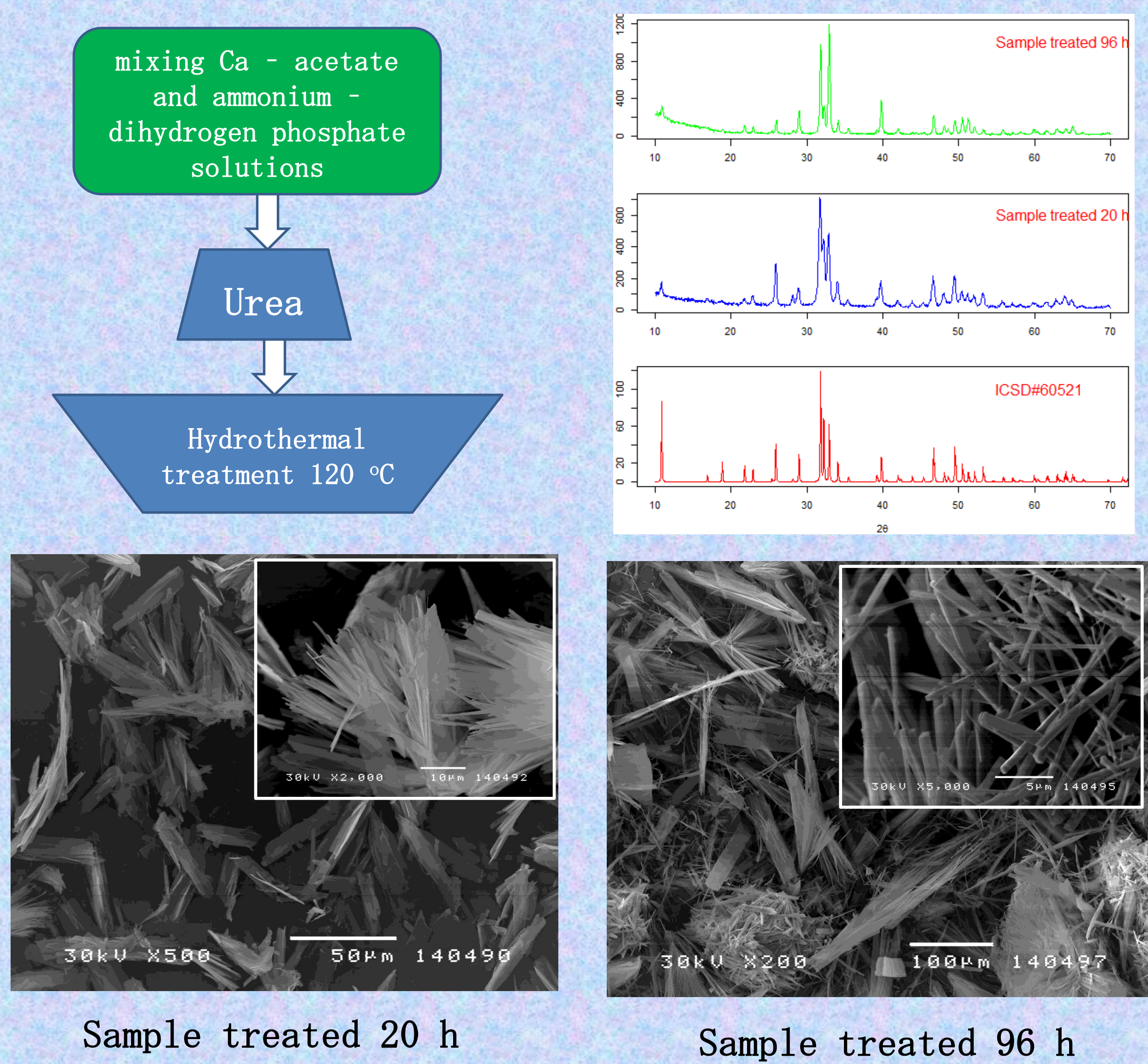
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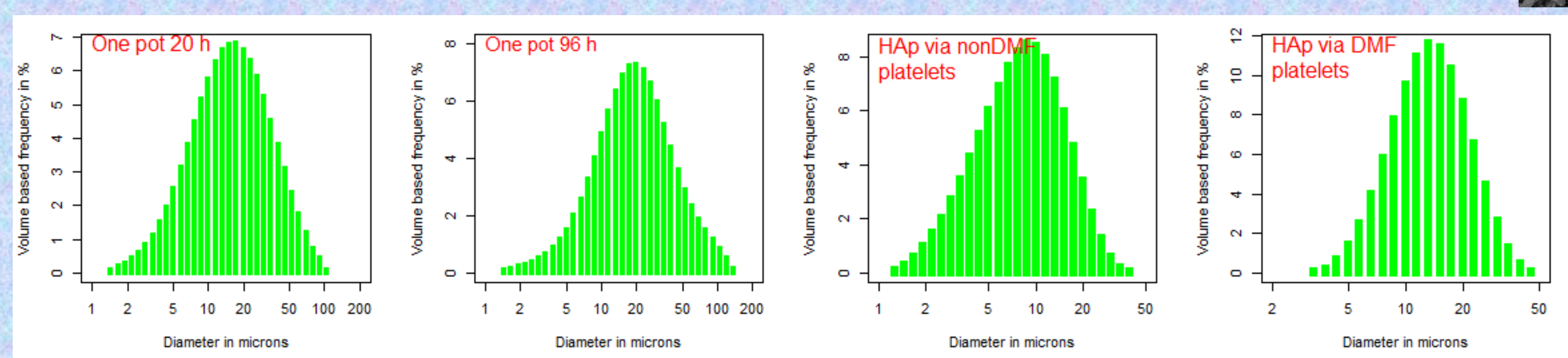[2] Laboratory for Electron Microscopy, Faculty of Medicine University of Niš, Dr. Zoran Đinđić Boulevard 81, Niš, Serbia
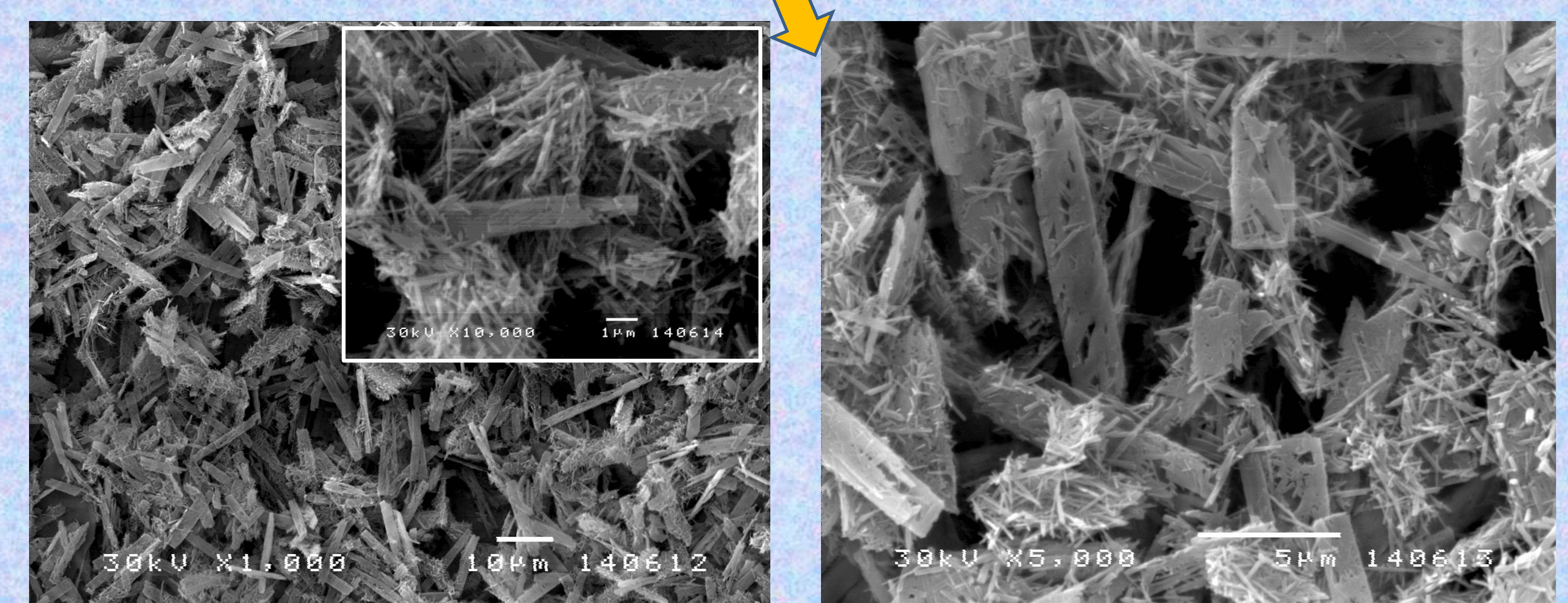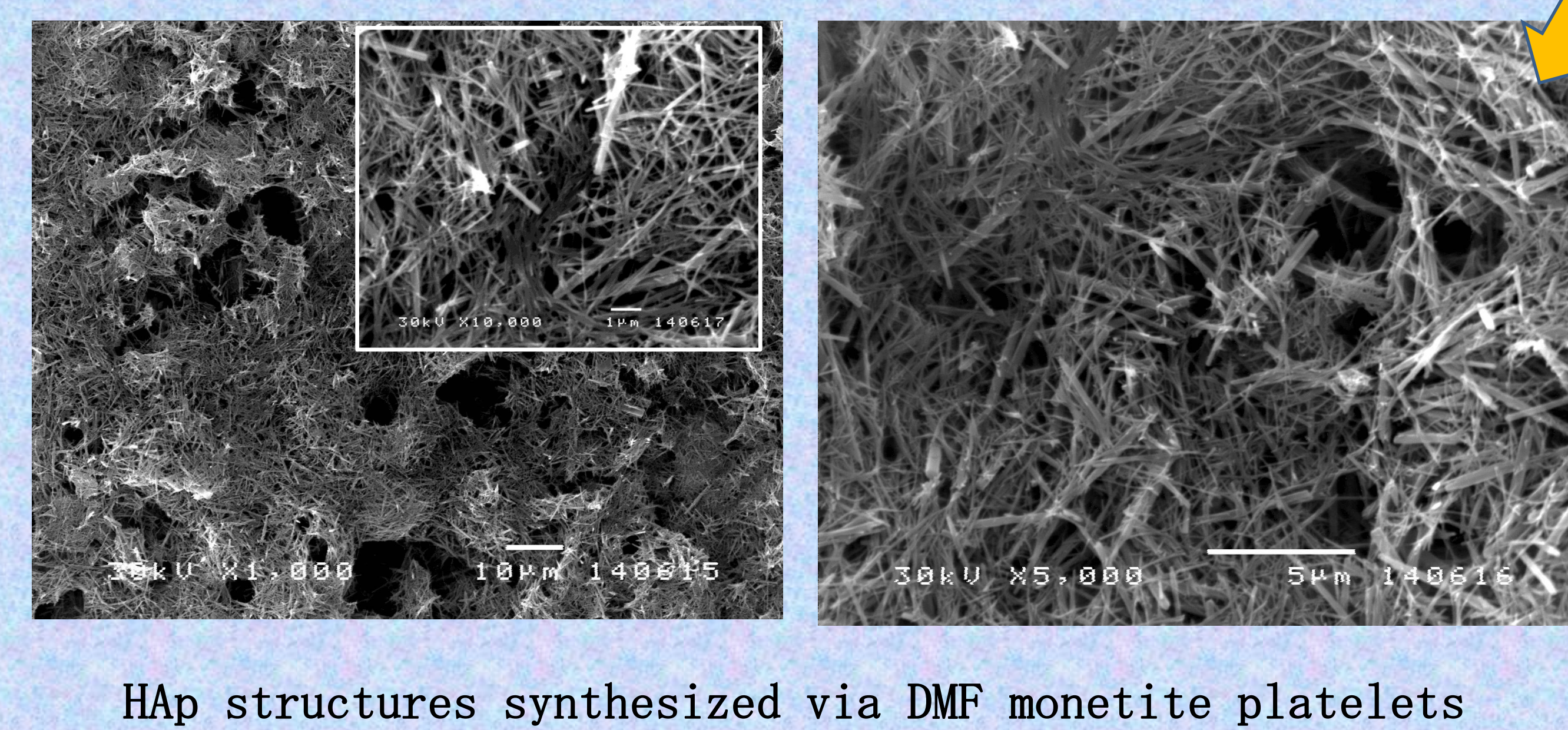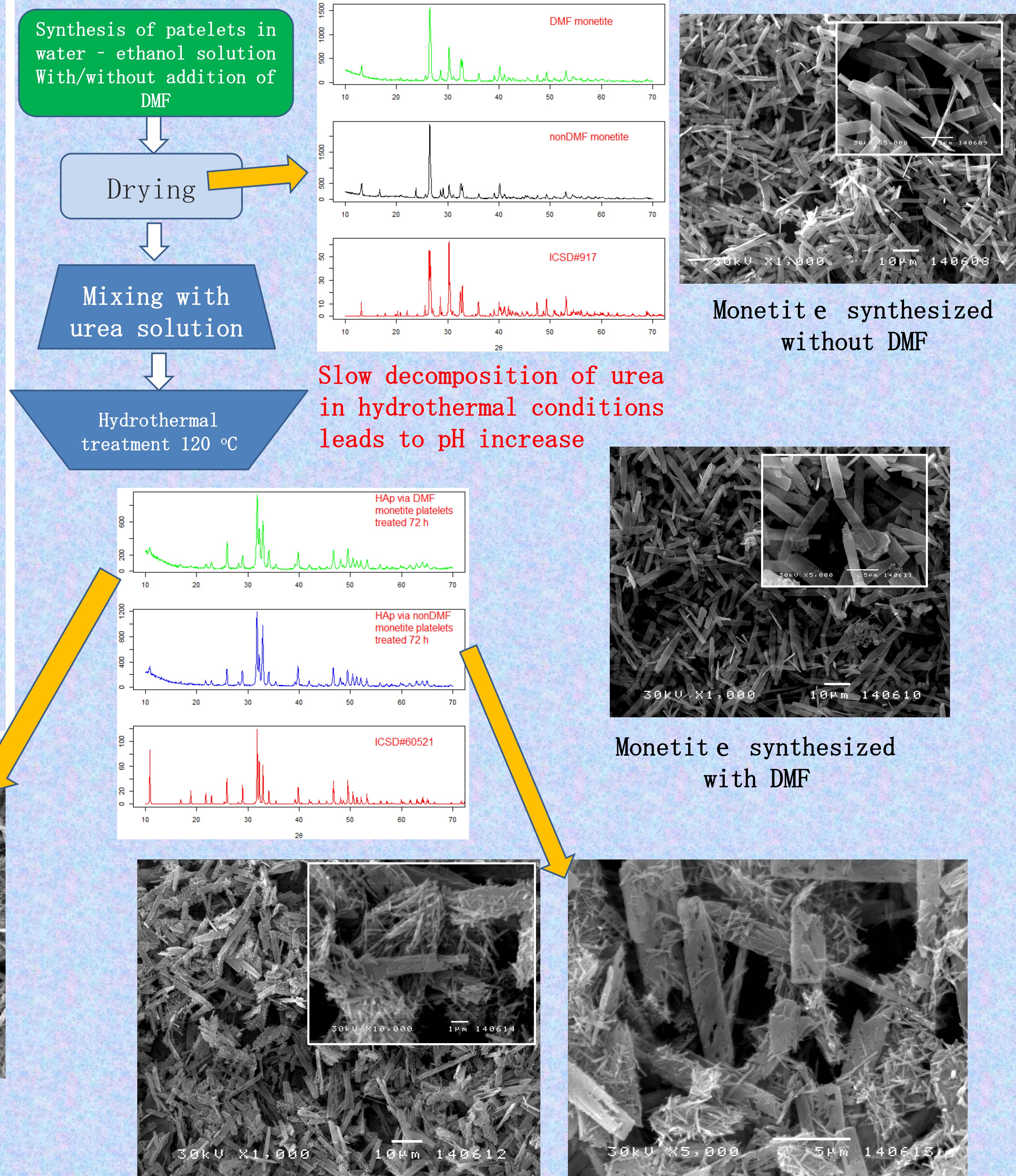
The 1D hydorxyapatite (HAp) nanostructures such as nanowires and nanotubes, have drown interest of biomedical researchers in field of scaffold and tissue engineering, drug delivery and biocomposites. Due to improvement of mechanical properties and large surface area they have found applications in bone tissue engineering. The target of this work is utilization of controlled precursor preparation and hydrothermal process for synthesis of such structures on a gram scale.

Synthesis Methods and Results

1. One pot synthesis of HAp using Ca-acetate precursor

mixing Ca - acetate and ammonium - dihydrogen phosphate solutions

Urea

Hydrothermal treatment 120 ℃

Sample treated 96 h
Sample treated 20 h
ICSD#60521

Sample treated 20 h

Sample treated 96 h

HAp structures synthesized via DMF monetite platelets

2. Synthesis of HAp using Ca oleate via monetite platelets

Synthesis of patelets in water - ethanol solution With/without addition of DMF

Drying

Mixing with urea solution

Hydrothermal treatment 120 ℃

Slow decomposition of urea in hydrothermal conditions leads to pH increase

DMF monetite
nonDMF monetite
ICSD#917

Monetite synthesized without DMF

HAp via DMF monetite platelets treated 72 h
HAp via nonDMF monetite platelets treated 72 h
ICSD#60521

Monetite synthesized with DMF

HAp structures synthesized via nonDMF monetite platelets

Size distributions of presented samples HAp obtained by laser diffraction method

One pot 20 h
One pot 96 h
HAp via nonDMF platelets
HAp via DMF platelets

Conclusion

The 2 key parameters seems to influence on whether nanowires will form during hydrothermal process or not.

The first parameter is crystal structure of precursor calcium phosphate, i.e. monetite. Orientation of crystal facets in monetite platelets seems to be important for formation of 1D structures.

The second parameter is time of hydrothermal treatment, i.e. time for urea decomposition reaction and concentration of OH^- ions. When concentration of precursor is too high or urea concentration (read OH^- conc.) is too low the alteration of monetit to HAp is incomplete. All synthesis are conducted on 120 ℃ and same urea concentration, also concentration of precursor, are varied within 0.03 to 0.04 $moldm^{-3}$. Since amount of data is insufficient for final conclusion, more run needs to be done to establish controlled synthesis of monetite platelets and HAp nanowires and nanotubes.

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