Supporting Information.

Novel polysaccharide Nanowires; Synthesized from Pectin-Modified Methacrylate

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Experiment Section

Materials and Methods. Pectin was purchased from Spectrum (USA). The other materials including Glycidyl methacrylate (GMA), sodium thiosulfate, calcium chloride (CaCl2), tetabutylammonium bromide (TBABr) were purchased from sigma Aldrich. 1H NMR spectra were recorded at room temperature on a Gemini 200-300 MHz NMR spectrometer (Varian). Hydrogel nanoparticles were characterized using a Mastersizer 3000 particle size analyzer (Malvern Instruments Ltd.), and scanning electron microscope (Carl Zeiss) what is the specification of sample for SEM.

Nuclear Magnetic Resonance Spectroscopy (NMR). ^{1}H spectra were acquired in a 200-300 MHz NMR spectrometer (Varian). Chemical shifts are reported in ppm, calibration was done on the deuterated solvent used in the experiments by the related software function. All measurements were performed at room temperature solubilizing 2-3 mg of each compound in deuterated chloroform.

Synthesis of methacrylate pectin. The polysaccharide aqueous solution was prepared for 2.5% of what mass or molar Pectin-USP Spectrum, 6.7% of mass or molar or volume methoxylation). After the complete solubilization of the polysaccharide, 4.8 mL of GMA (pH 3.5) was added to the solution and maintained under mechanical agitation for 24 h at 50oC. Afterwards, the ethanol was added to precipitate the modified pectin. Finally, after filtration, the modified pectin was lyophilized.

Preparation of MA-pectin nano particles. An aqueous phase consisting of 15% molar mass of pectin and 0.1 mM sodium persulfate (SP) was mixed into ethanol by stirring at 6000 rpm under a bubbling stream of nitrogen for 5 min. The water/ ethanol mixture composition was used in the 1:4 proportions (water: ethanol, the volume of ethanol corresponded to four times of the water volume). The final mixture was then vigorously stirred by a high mixing with speed of 12,000 rpm at room temperature. 20% molar mass surfactant with respect to pectin was dissolved in 2 ml of dodecane,

which was added drop wise under constant stirring into polymer solution mixtures. Then, the solution was added drop wise into dodecane (5 ml) and kept conducted for sonication at 50 °C for 1 hour. After the solution kept for 10 minutes for settling; again ethanol was added and centrifuged to remove completely water and dodecane from the emulsification. The washing process with ethanol was repeated 8 to 10 times to ensure to remove complete impurities. Finally, the 60 ml dispersed pectin particle solution was added on silicon carbide and dried overnight under vacuum for 24 hours to characterize with SEM as added on silicon carbide and dried overnight under vacuum for 24 hours to characterize with SEM.

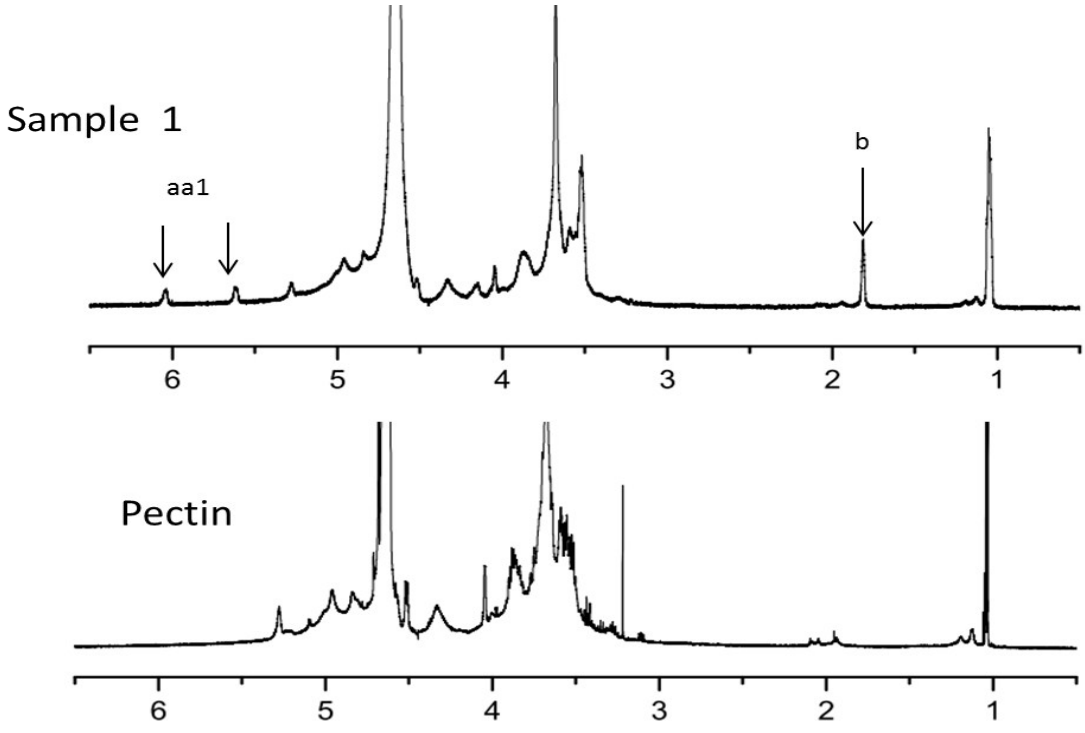


Figure S1. [1]HNMR of pectin and methacryale pectin a- pectin- Sample 1).

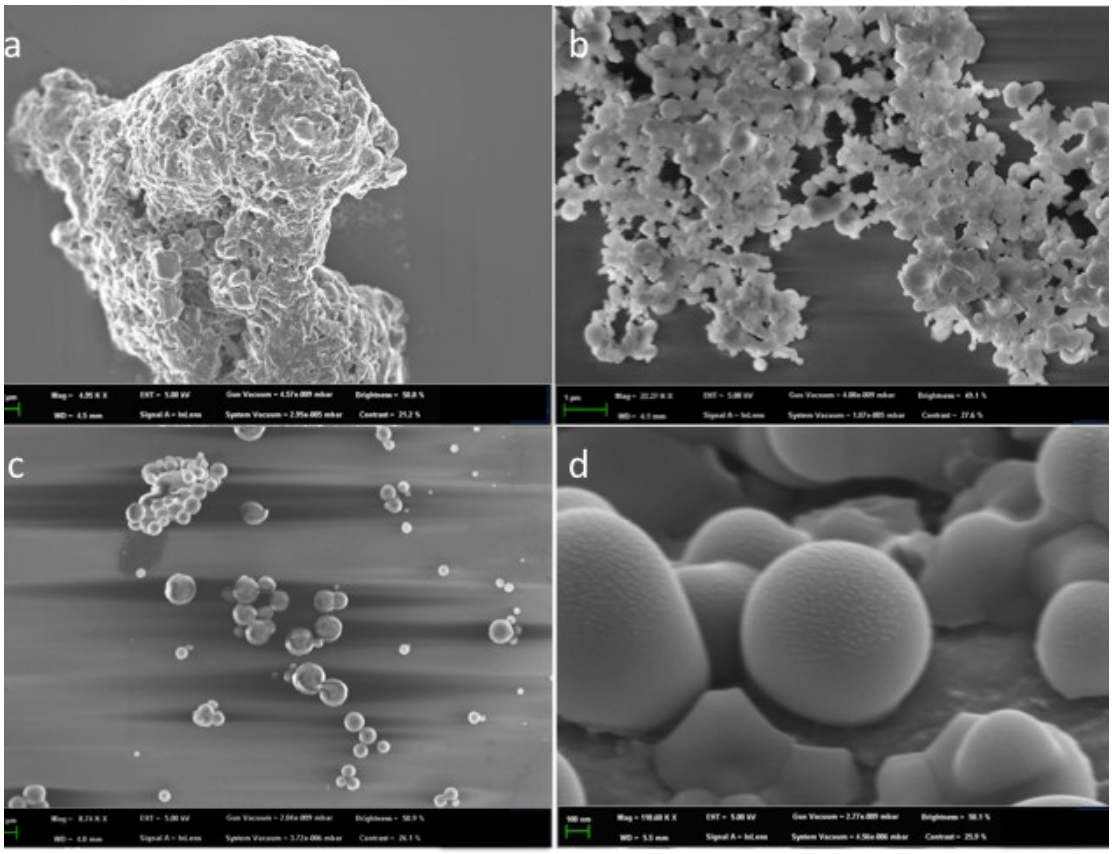


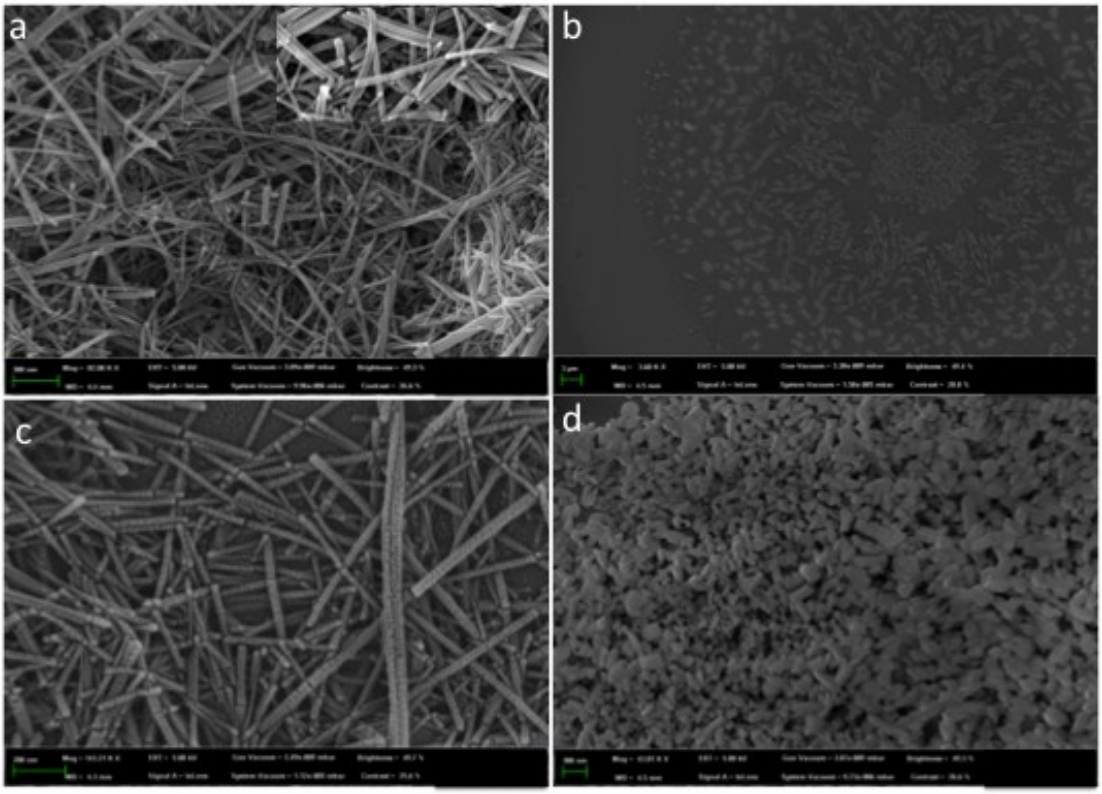
Figure S2. SEM images of a) Ma-pectin, b) After emulsification with dodecane 30 minutes sonication, c) 1 hour sonication with dodecane and d) microscopy images of single nanoparticle.

Preparation MA-pectin nanorods/fibers.

Ma-Pectin (100mg) in 4ml H_2O was stirred for 30 minutes till the solution became clear solution then, 1mg of sodium per sulfate was added and the solution kept for 24 hours stirring at 50 ^{O}C. The $CaCl_2$ (100mg) was prepared in 2ml H_2O then the pectin-MA solution were added dropwise into $CaCl_2$ solution under constant stirring for 24 hours. 20% surfactant with respect to pectin was dissolved in 2 ml of ethanol was added drop wise with constant stirring into polymer solution mixtures. The polymer mixtures were added drop wise into toluene (20 ml) and kept for sonication at 50 ^{O}C for 2 hours. 20 ml acetone was added into emulsified solution and centrifuged to remove toluene from the mixtures. The washing procedure was repeated 7-8 times to remove complete toluene from the system.

Preparation of egg box-pectin nanowires.

Pectin-MA (100mg) in 4ml H_2O was stirred for 30 minutes until the mixture became clear, then 1mg of sodium per sulfate was added to mixture and kept stirring at 50 ^{O}C for 24 hours. Prepare $CaCl_2$ (100 mg) in 2 ml H_2O and then, polymer solution were added drop wise into $CaCl_2$ solution under constant stirring. The polymer solution mixtures were added drop wise into toluene (20 ml) and kept for sonication at 50 ^{O}C for 2 hours. 20 ml acetone was added into emulsified solution and centrifuged to remove toluene from the mixtures. The washing procedure was repeated 7-8 times to remove complete toluene from the system.



S3. SEM images of (a) nanorods, (b) Egg-box structure of pellets, C) Morphology of grown from egg-box structure into nanowires and (d) nanowires morphological behavior of modified pectin and pellets like structure of pectin treated surfactant.

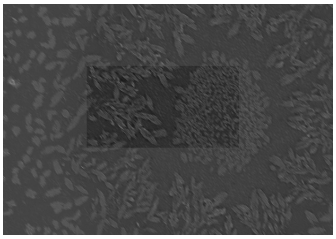
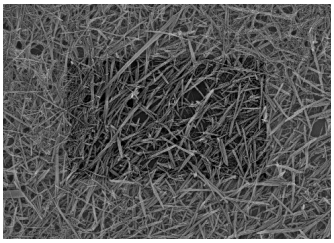
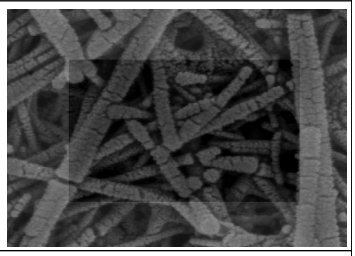
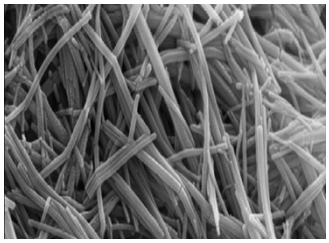
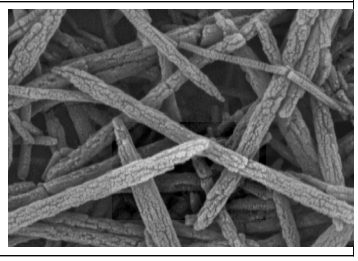
Conditions	Morpohological structure	Conditions	Morpohological structure
1% pectin (sonication at 50 ^{O}C for 2 hours)		5% pectin (sonication at 50 ^{O}C for 60 minutes)	
2% pectin (sonication at 50 ^{O}C for 2 hours)		5% pectin (sonication at 50 ^{O}C for 90 minutes)	
3% pectin (sonication at 50 ^{O}C for 2 hours)		5% pectin (sonication at 50 ^{O}C for 120 minutes)	

Table S1. The table represents the synthetic conditions of pectin nanowires with morphological structures.

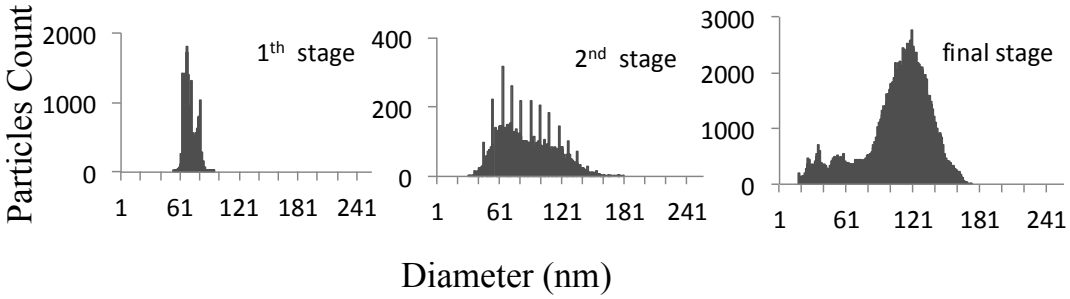


Figure S4. Histogram of pectin nanowires fabrication. 1st stage indicates 5% of pectin, sonication at 50 ^{O}C for 60 minutes. 2nd stage shows the histogram of pectin growing nanowires, sonication at 50 ^{O}C for 90 minutes and Final stage confirms the histogram of pectin grown nanowires, sonication at 50 ^{O}C for 120 minutes.