Recombinant DNA strategy used to make spider silk block copolymers

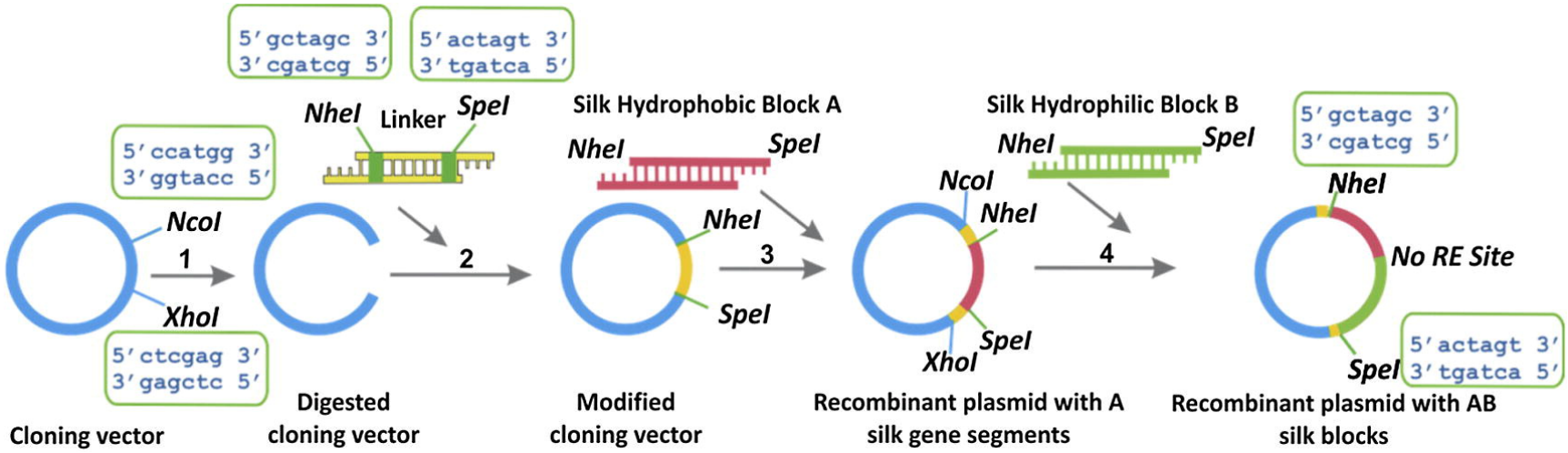

Fig.1 Schematic representation of the recombinant DNA strategy used to make spider silk block copolymers for the study. The A block consisted of one polyalanine/polyglycine repeat (GAGAAAAAGGAG) responsible for β-sheet formation. The B block was composed of four GGX repeats, separated by the GSQGSGR sequence. *NcoI*, *NheI*, *SpeI*, *XhoI* are restriction enzymes (RE). A box above/below a specific RE indicates an oligonucleotide sequence recognized by this RE. pet30a(+) plasmid is in blue, cloning linker is in yellow, silk hydrophobic block A is in magenta, and silk hydrophilic block B is in green. Steps are the following: (1) digestion, (2) ligation of a linker, (3) ligation of A block, (4) ligation of B block.

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Integrated experimental – modeling approach in action.

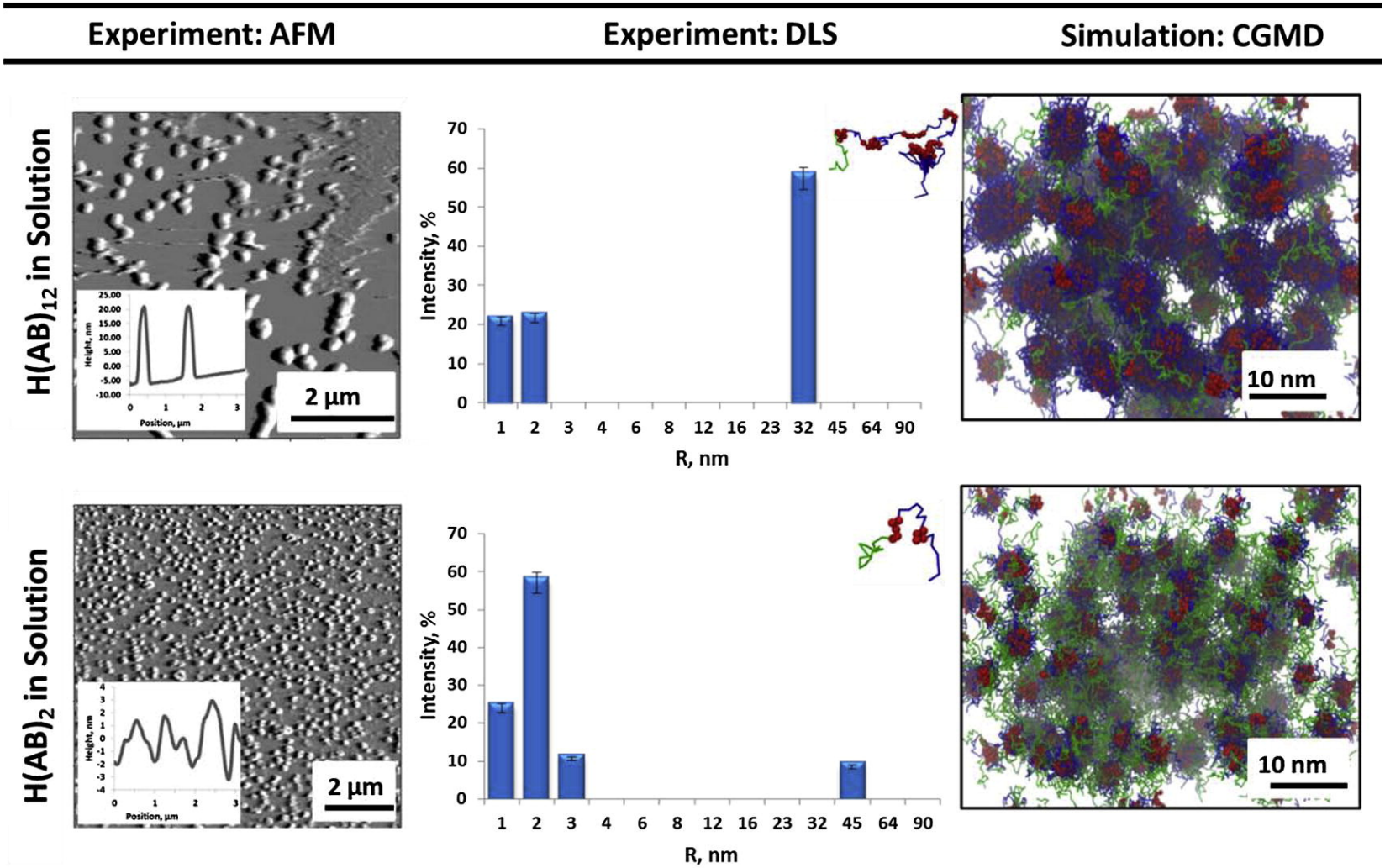

Fig.2. Comparison among AFM, DLS, and coarse-grained molecular dynamic (CGMD) simulation results on aggregate morphologies of $H(AB)_{12}$ and $H(AB)_2$ recombinant spider silk block copolymers in aqueous solution. Experimental panel (AFM and DLS) depicts that $H(AB)_{12}$ formed larger micelles with an average diameter of 32 nm ± 5 nm and $H(AB)_2$ self-assembled into smaller micelles with an average diameter of 2 nm ± 0.5 nm. For both types of spider silk block copolymers, micelles were observed at concentration of 0.25 mg/ml in aqueous media. The simulation results (simulation panel) depicts formation of the small spherical aggregates in the case of $H(AB)_2$ and large spherical aggregates in the case of $H(AB)_{12}$.

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Nano-fibrillar assemblies of $H(AB)_{12}$ block copolymer after spinning

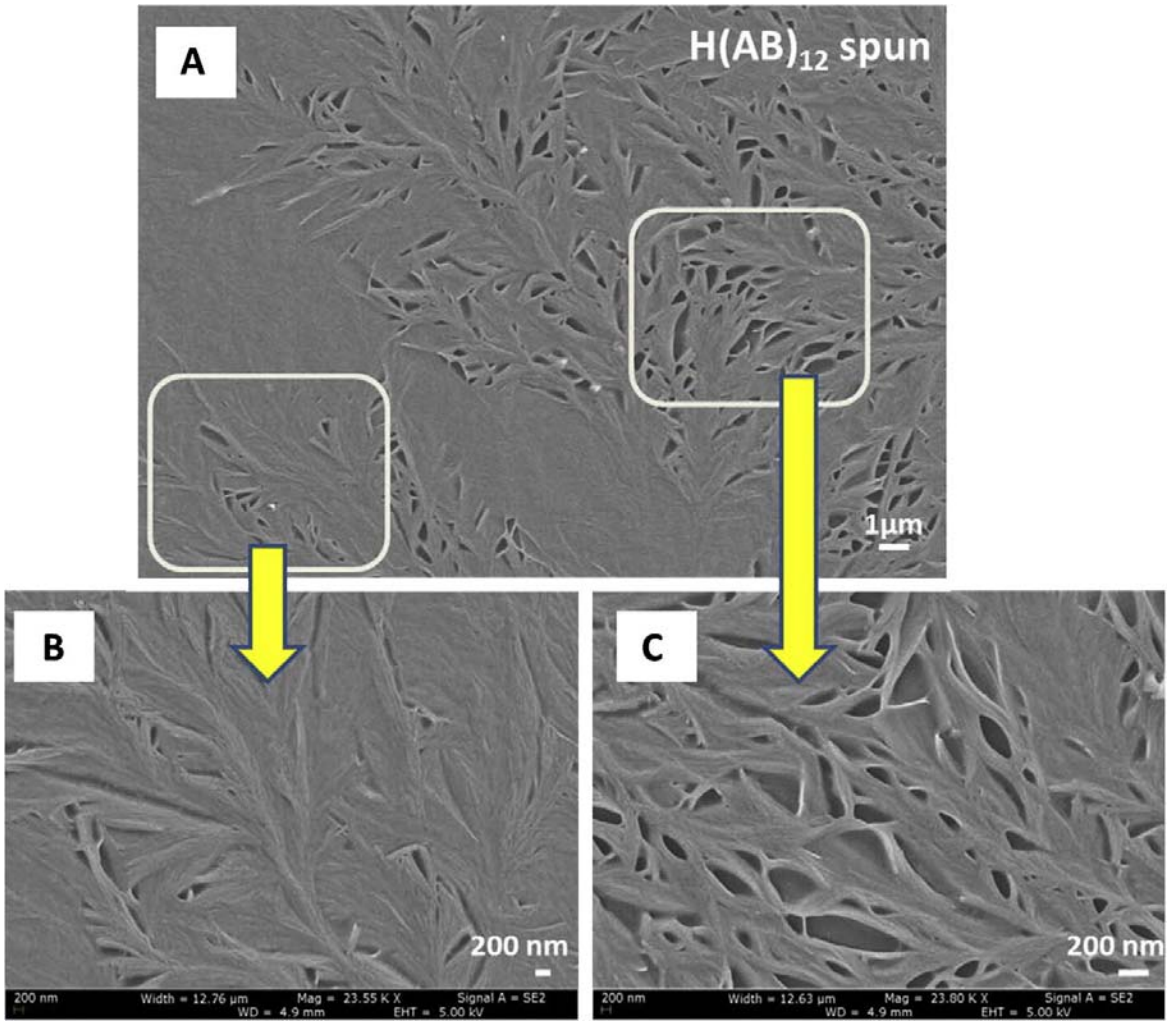

Fig.5. (A) SEM spun $H(AB)_{12}$ at 20% w/v. (B, C) Nano-fibrillar assemblies were observed for spun $H(AB)_{12}$ film. $H(AB)_{12}$ film was washed with water, air dried, and imaged at 5 kV. The film is composed of densely-packed and loosely-packed regions of interwoven nano-fibrils.

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