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Self-Assembled Biomaterials Lab

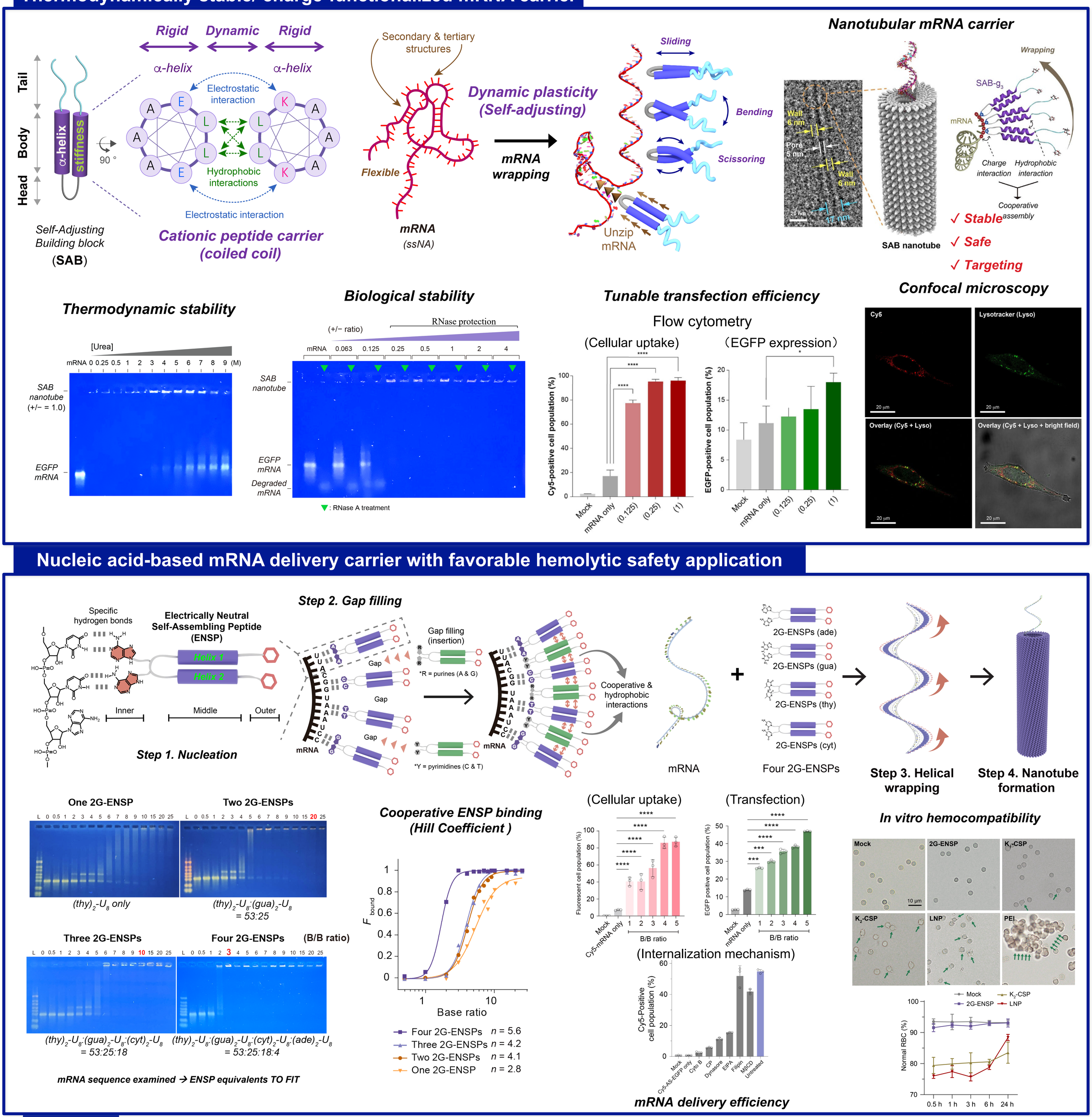
From Thermodynamic Stability to Hemocompatibility: Self-Assembling Peptide Nanotubes for mRNA Delivery

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Introduction

While mRNA delivery technology holds significant potential for vaccines and therapeutics, the development of carriers with sufficient stability and safety remains a major challenge. Conventional mRNA carriers are predominantly based on cationic or amphiphilic materials, which efficiently condense mRNA but may cause cyt otoxicity and undesirable membrane interactions. Recent studies have demonstrated that electrically neutral self-assembling peptides can provide an alternative strategy by organizing mRNA through cooperative hydrogen-bonding and hydrophobic interactions while minimizing cytotoxic effects. Moreover, considering the i ntrinsically filamentous nature of mRNA, the formation of nanotubular assemblies may offer greater structural and thermodynamic stability than conventional sphe rical architectures. Peptide–mRNA nanotubes can thus generate virus-like structures in which peptide building blocks cooperatively assemble along the mRNA str and, providing a stable and well-defined supramolecular architecture. Together, these findings highlight the potential of neutral peptide-based nanotubes as a safe r and more durable platform for mRNA delivery.

Thermodynamically stable/ charge-functionalized mRNA carrier



Nucleic acid-based mRNA delivery carrier with favorable hemolytic safety application

Reference

- Zihao Zhang *et al.* "Nontoxic mRNA Vehicles based on Electrically Neutral Self-assembling Peptides." ***Nature Communications,*** In press
- You-jin Jung *et al.* "Cooperative Assembly of Self-Adjusting α-Helical Coiled Coils along the Length of an mRNA Chain to Form a Thermodynamically Stable Nanotube Carrier." ***Journal of the American Chemical Society,*** In press