Diamond-like carbon binding peptides

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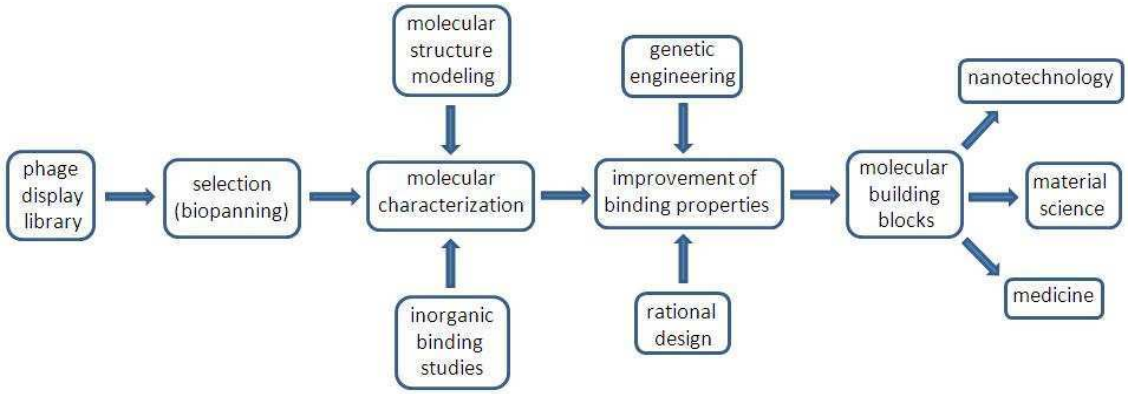

Flowchart of evolutionary selection of solid-binding peptides, their molecular characterization, tailoring their function, binding properties, utilization, and possible applications.

Material binding peptides have attracted great interest in nanotechnology and molecular biomimetics. They are good models for studying molecular recognition between proteins and inorganic surfaces, and also offer many possibilities for utilization in modern applications such as biomimetic composite materials, biosensing, tribology, nanoelectronics, drug delivery and bioremediation.

Phage display is a versatile, combinatorial technique that allows selecting short, material-specific peptides from libraries of billions of different variants. Selected peptides can be studied by experimental and computational methods to define their sequence, structure and binding properties, subsequently engineered with the use of recombinant DNA technologies in order to improve their binding affinity and tailor their function. Selected, investigated and genetically engineered material-specific peptides can be utilized as building blocks for various nanotechnological applications that require target specific recognition.

In these studies we identified diamond-like carbon binding peptides (DLCBP) from the PhD-12 NEB (New England Biolabs) phage display library. During the selection process, phage displaying longer than standard 12 amino acid peptides (generally present in PhD-12 NEB library) were enriched. Binding studies of selected phage clones by phage ELISA and phage titer analysis indicated that phage displaying long peptides bind more efficiently to DLC surface than phage displaying standard 12-mer peptides. Selected DLCBP were fused to bacterial alkaline phosphatase (AP) which (was used as a reporter enzyme) in order to determinate their binding properties outside of the phage particle context. Adsorption of the DLCBP-AP fusions on DLC was quantified using the AP enzymatic activity and verified by ellipsometry. The long peptide DLCBP11(L)-AP showed the highest binding to DLC according to Langmuir one-site binding model, with a binding capacity of 6.8 ± 0.4 pmol/cm2 and a Kd-value of 63 ± 14 nM. The exact molecular mechanism of binding of DLCBP11(L) is for the moment still unknown.

DLCBP as fusion partners of proteins have been also utilized in the synthesis of nanoparticles and in friction tests with the use of DLC surface.