論文 / 著書情報
Article / Book Information

題目(和文)	層状物質の表面における自己組織化ペプチドの分子認識
Title(English)	Molecular recognition of self-assembled peptides on layered materials
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Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

専攻： Department of	有機・高分子物質　専攻	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of　（　　）
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

In my thesis, molecular recognition of self-assembled peptides on layered materials is investigated. The content of this work is included by the following chapters

In chapter 1, an introduction about molecular self-assembly on solid surfaces, especially the self-assembly of peptides on layered materials such as mica and HOPG. Then, the methods to synthesize MoS_2 are summarized.

In chapter 2, self-assembly of M6 and chiral M6 (CM6) peptides on MoS_2 and graphene is discussed. First of all, the morphology of M6 peptide on MoS_2 and graphene with a wide range of peptide concentrations is depicted, showing highly ordered structures. Then, the crystallographic orientation of self-assembled peptides on CVD MoS_2 is determined by measuring the angle formed by peptide nanowires and edge of CVD MoS_2 with certain facet. M6 and CM6 peptides form 33 and 27 degree offset with the zigzag edge of CVD MoS_2, respectively. Thirdly, the chirality recognition of M6 and CM6 on CVD MoS_2 is discussed as well. Fourthly, the high resolution *in situ* AFM results give the periodicity of self-assembled M6 peptides along nanowire direction and the direction perpendicular to nanowires. An atomic model is used to explain the specific crystallographic orientation and lattice matching between self-assembled peptides and MoS_2 lattice. The results from crystallographic orientation and high resolution *in situ* AFM results show that they have good lattice matching along nanowire direction and direction vertical to nanowires. Finally, the effects of temperature and concentrations on crystallographic orientation of M6 and CM6 on CVD MoS_2 are illustrated. The temperature and peptide concentrations don't affect the crystallographic orientation of both peptides on CVD MoS_2.

In chapter 3, self-assembly of FI and FI (k) peptides on MoS_2 is discussed. First of all, the morphology of FI and FI (k) peptides on MoS_2 with different concentrations is depicted. FI peptides self-assemble into a long-range ordered structure. They may form an antiparallel structure on surface. However, FI(k) peptides mainly form disordered phases. Then, the crystallographic orientation and chirality recognition of FI on CVD MoS_2 are observed. Finally, High resolution *in situ* AFM results give the periodicity of self-assembled FI peptides along direction vertical to nanowires.

In chapter 4, self-assembly of Y(GA)nY (n=3,4,5) peptides on MoS_2 and graphene is

investigated. The Y(GA)nY peptides can form strong hydrogen bond interaction between two peptides. First of all, the morphology of Y(GA)nY peptide on MoS_2 and graphene with different concentrations is depicted. All the Y(GA)nY peptides can self-assemble into ordered structures on both substrates. The nanowire and nanosheet structures can be observed. Then, the CD measurements are done to characterize the structure of Y(GA)nY in solution. Thirdly, the adjustment of crystallographic orientation about self-assembled Y(GA)nY on CVD MoS_2 by using different peptide length is discussed. Fourthly, the effect of various inorganic salts on morphology of Y(GA)3Y-COOH and Y(GA)3Y-$CONH_2$ peptides on bulk MoS_2 is investigated. Finally, the effect of temperature on morphology of Y(GA)3Y-COOH and Y(GA)3Y-$CONH_2$ peptides on bulk MoS_2 is investigated.

In chapter 5, self-assembly of two novel peptides, LEY and LKY, on graphite and MoS_2 is studied. First of all, the morphology of LEY and LKY peptide on MoS_2 with different concentrations is depicted. The negatively charged LEY peptides can form ordered structure on both substrates. However, the positively charged LKY peptides mainly form aggregation on both substrates. Then, the crystallographic orientation of LEY peptides on CVD MoS_2 is investigated. Fourthly, the effects of various inorganic salts and temperature on morphology of LEY and LKY peptide on MoS_2 are discussed. Finally, the stability of LEY and LKY peptides on graphite and MoS_2 in a wide range of peptide concentrations is illustrated during water soaking.

In chapter 6, sequential assembly of one peptide on preformed patterned nanostructure of another peptides on graphite is investigated. First of all, the morphology of GrBP5 peptides on patterned nanostructure of LEY peptide on graphite is observed. GrBP5 peptides also self-assembled into ordered phases on preformed nanostructures of LEY peptides. In addition, the crystallographic orientation of GrBP5 peptides on graphite is the same as the one of LEY peptides. Then, controlling the crystallographic orientation of M6, M6±D and M8 peptides on graphite by organized LEY peptides is discussed. These peptides have different angle offset with the nanowires formed by LEY peptides Finally, a concept about controlling growth of one peptide by another patterned peptide is demonstrated.

These chapters discussed above can make us have a good understanding about molecular recognition mechanism. In addition, the molecular recognition of self-assembled peptides on single layer MoS_2 would open a new door for further engineering of the electrical prosperities of two dimensional nanomaterials.