

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
著者(和文)	孫林豪
Author(English)	Linhao Sun
出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第10370号, 授与年月日:2016年12月31日, 学位の種別:課程博士, 審査員:早水 裕平,森 健彦,バツハ マーティン,松本 英俊,道信 剛志
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第10370号, Conferred date:2016/12/31, Degree Type:Course doctor, Examiner:,,,,,
学位種別(和文)	博士論文
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:	有機・高分子物質	専攻
Department of		
学生氏名:	Sun Linhao	
Student's Name		

申請学位(専攻分野):	博士	()
Academic Degree Requested	Doctor of	
指導教員(主):	早水 裕平	
Academic Advisor(main)		
指導教員(副):		
Academic Advisor(sub)		

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 MoS₂ are summarized.

In chapter 2, self-assembly of M6 and chiral M6 (CM6) peptides on MoS₂ and graphene is discussed. First of all, the morphology of M6 peptide on MoS₂ 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 MoS₂ is determined by measuring the angle formed by peptide nanowires and edge of CVD MoS₂ with certain facet. M6 and CM6 peptides form 33 and 27 degree offset with the zigzag edge of CVD MoS₂, respectively. Thirdly, the chirality recognition of M6 and CM6 on CVD MoS₂ 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 MoS₂ 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 MoS₂ are illustrated. The temperature and peptide concentrations don't affect the crystallographic orientation of both peptides on CVD MoS₂.

In chapter 3, self-assembly of FI and FI (k) peptides on MoS₂ is discussed. First of all, the morphology of FI and FI (k) peptides on MoS₂ 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 MoS₂ 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 MoS₂ 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 MoS₂ 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 MoS₂ 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-CONH₂ peptides on bulk MoS₂ is investigated. Finally, the effect of temperature on morphology of Y(GA)3Y-COOH and Y(GA)3Y-CONH₂ peptides on bulk MoS₂ is investigated.

In chapter 5, self-assembly of two novel peptides, LEY and LKY, on graphite and MoS₂ is studied. First of all, the morphology of LEY and LKY peptide on MoS₂ 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 MoS₂ is investigated. Fourthly, the effects of various inorganic salts and temperature on morphology of LEY and LKY peptide on MoS₂ are discussed. Finally, the stability of LEY and LKY peptides on graphite and MoS₂ 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 MoS₂ would open a new door for further engineering of the electrical prosperities of two dimensional nanomaterials.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note: Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1 copy of 800 Words (English).

注意：論文要旨は、東工大リサーチリポジトリ (T2R2) にてインターネット公表されますので、公表可能な範囲の内容で作成してください。

Attention: Thesis Summary will be published on Tokyo Tech Research Repository Website (T2R2).