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材料物理和化学

表面修饰制备高性能薄膜晶体管

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摘要: 应用聚苯乙烯/氯硅烷复合材料作为栅绝缘层的界面修饰层制备了高性能的并五苯场效应晶体管。原子力显微镜观察发现, 界面修饰对并五苯半导体薄膜的生长形貌产生了很大影响。在空白二氧化硅上沉积的并五苯晶粒尺寸都小于150 nm, 而在修饰过后二氧化硅的表面生长的并五苯晶粒尺寸多在200~400 nm。大的晶粒尺寸能够减小晶粒间的界面, 从而有效提高电学性能。表面改性的并五苯场效应晶体管的关态电流约为 $10^{-10}$  A, 电流的开关比超过 $10^6$ , 最大场效应迁移率约可达 $1.23 \text{ cm}^2 \cdot \text{V}^{-1} \cdot \text{s}^{-1}$ , 而未处理的晶体管的场效应迁移率仅有 $0.0118 \text{ cm}^2 \cdot \text{V}^{-1} \cdot \text{s}^{-1}$ 。

关键词: 有机薄膜晶体管 二氧化硅表面修饰 电性能

## Preparation of High-Performance Organic Thin-Film Transistor Through Surface Modification

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Abstract: High-performance pentacene organic thin film Transistor (OTFT) with interface modification layer of polystyrene/chlorosilane composite material was developed. The AFM images show that the growth morphology of pentacene semiconductor film was affected by interface modification. The pentacene grains grown on modified  $\text{SiO}_2$  substrates with dimensions in the range of 200~400 nm are larger than those grown on bare  $\text{SiO}_2$  substrates which have sizes less than 150 nm. Large particle size can reduce intergranular interface so as to improve the electrical performance. The output and transfer curve, on/off current ratio, threshold voltage and field-effect mobility of the device were obtained by electric measurements. The transfer curve showed an on/off current ratio exceeding  $10^6$  with the off-current of about  $10^{-10}$  A. The device with interface modification has a maximum field-effect mobility of up to  $1.23 \text{ cm}^2 \cdot \text{V}^{-1} \cdot \text{s}^{-1}$ , compared to the  $0.0118 \text{ cm}^2 \cdot \text{V}^{-1} \cdot \text{s}^{-1}$  of OTFT on bare  $\text{SiO}_2$  substrate.

Keywords: organic thin film transistor surface modification electrical properties

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