FUNDING PROGRAM FOR NEXT GENERATION WORLD-LEADING RESEARCHERS

Project Title: Development of structure control and low-temperature process of oxide semiconductors toward high-speed, low-power consumption flexible devices	
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1. Background of research

The current information society is based on high-performance semiconductor devices, but these require expensive and small-size single-crystalline Si wafers. On the other hand, we require different type devices such as large-area giant microelectronics represented by solar cells and flat-panel displays (FPDs). These require very large substrates over 2 m^2 areas; therefore, the current FPDs use amorphous silicon (a-Si). However, a-Si devices are not applicable to future giant microelectronic devices such as organic light-emitting diode displays, ultra high-resolution displays, and jumbo-size high-speed 3D displays due to its low physical properties.

Amorphous Oxide Semiconductor (AOS) is a new semiconductor material and overcomes the drawback of a-Si. To date, several display manufactures have demonstrated prototype displays. However, the potential of AOS devices would be much higher and wider, and we anticipate that AOS technology will be applied to further extended applications by developing low-temperature fabrication techniques and controlling methods for defects and atomic structures of AOSs.

2. Research objectives

The objective of this project is to realize high-performance flexible devices using AOS. For example, fabrication temperatures <150°C, field-effect mobility >30 times of a-Si, low-voltage operation at < 3 V, and high-speed operation at > 1 GHz are the targets.

3. Research characteristics (incl. originality and creativity)

The originality is that AOS is a semiconductor materials completely different from Si, and we have developed it by ourselves. The development of AOS displays have been performed by display manufactures, but they are not experts of oxide materials and the fundamental materials science of AOS has yet been clarified satisfactory. We can solve this issue as an expert of oxide semiconductor materials and also as a creator of AOS.

4. Anticipated effects and future applications of research

This technology will develop high-performance flexible electronic devices on any substrates including glass, plastics, and even paper. Also, AOS devices can be transparent. These will enable to develop new ubiquitous information devices such as, light weight, flexible, natural, and even transparent integrated in window glass.