**FUNDING PROGRAM FOR NEXT GENERATION WORLD-LEADING RESEARCHERS**

| **Project Title**: Fundamental and application of transparent semiconductor spintronics | |
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**1. Background of research**

An innovative technology “beyond CMOS technology” surpassing modern semiconductor electronics is needed for further development in semiconductor electronics. A promising candidate for the beyond CMOS technology, semiconductor spintronics, enables to control another degree of freedom in electron, i.e. spin, in addition to the charge as in semiconductor devices. Ferromagnetic semiconductor that has both ferromagnetic and semiconducting properties is known as the semiconductor spintronic material. However, the Curie temperature is below room temperature. Although room temperature ferromagnetism was reported recently, intrinsic property as the ferromagnetic semiconductor was not established. Room temperature ferromagnetic semiconductor is needed for advances in semiconductor spintronics.

**2. Research objectives**

A transparent oxide semiconductor titanium dioxide, that is also known as a photocatalyst, shows ferromagnetism at room temperature by doping cobalt, although the mechanism of ferromagnetism was unclear. If electron carriers mediate the ferromagnetic exchange coupling, cobalt-doped titanium dioxide is an intrinsic room temperature ferromagnetic semiconductor. Then, the amplitude of magnetization can be controlled by changing electron density, leading to establishment of an important element technology for spintronic devices. Recently, we succeeded in observation of electric field-induced ferromagnetism at room temperature. In this project, we aim at the operation of semiconductor spintronic devices at room temperature by developing methods to control the ferromagnetism. Such development needs further understanding of basic properties, thus we also try to elucidate the mechanism of room temperature ferromagnetism.

**3. Research characteristics (incl. originality and creativity)**

We are about to control ferromagnetism at room temperature. By demonstrating operation of spintronic device at room temperature, we will open the way to applications of semiconductor spintronics. cobalt-doped titanium dioxide is semitransparent and electrically conducting ferromagnet, thus various applications will be possible.

**4. Anticipated effects and future applications of research**

Semiconductor spintronic devices using ferromagnetic semiconductor will lead to realization of low power consumption and/or long lifetime innovative devices. The semitransparent nature will be useful for realization of ubiquitous devices on window glass, for example.