Ultrafast nanoscale optical properties of phase change materials and its possible applications to neuron-inspired devices

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In the last few decades the development of optical data storage was focused on increasing the recording density. Although numerous efforts have been made for bit size reduction, current data storage technologies will reach their physical limits in the next decade. As a new trend of advanced storage technologies, bio-inspired cognitive memory is attracting much attention for its multifunctionality and possibility for energy consumption saving. Recently we have proposed neurobiologically inspired devices based on phase change material (PCM) interacting with a plasmon particle network (Fig. 1).

So far we have experimentally demonstrated ultrafast and nonthermal amorphization of GeSbTe thin films by femtosecond optical pulse excitation. We have also found that the nonthermally amorphized phase can be more efficiently crystallized than the melt-quenched amorphous phase. These ultrafast phase change dynamics are closely related to nanoscale structures formed in GeSbTe: ordered and disordered subunits. In this presentation, we discuss possible impacts of the ultrafast nanoscale characteristics of PCM on future neuron-inspired devices.

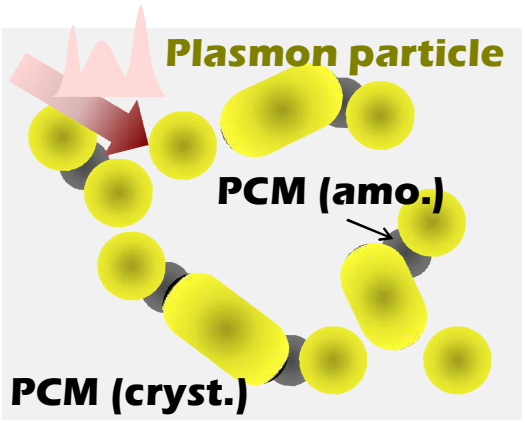

Figure 1: Conceptual illustration of a neuron-inspired device based on phase change material (PCM) interacting with a plasmon particle network.