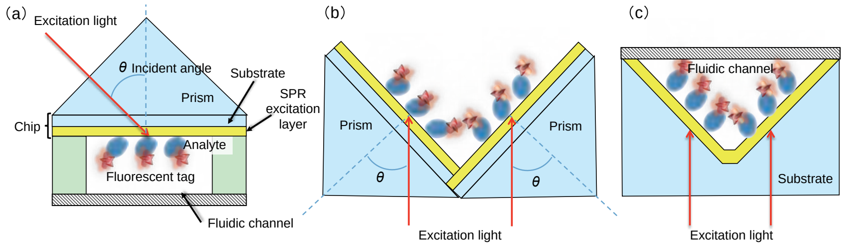
A microfluidic channel for detection of low-concentration biological substances

Simple mechanism and easy operation realized by integrating a microfluidic channel and optical systems

We have developed a biosensor system with both high sensitivity of surface plasmon resonance fluorescence (SPRF) and easy operability of a microfluidic channel. The microfluidic channel has a V-shaped cross section, so the sensor was named “V-trench biosensor”. The V-shaped channel works as an optical prism for induction of surface plasmon resonance (SPR). By forming an SPR excitation layer inside of the channel and illuminating the layer under an appropriate condition, the SPRF phenomenon is induced. As a result, the V-trench biosensor can detect target biological substances with high sensitivity by enhancing light signals from fluorescent dye attached to the target substances. The sensor also has a distinctive feature of having the optical system aligned in a straight line, which makes the system very simple. In addition to enabling more accurate diagnosis at clinical sites, the sensor is expected to contribute as a biosensor for daily health management.



(a) Conventional optical system for SPRF excitation
Detection chip is affixed to the bottom of the prism; fluidic channel is bonded to the surface of the detection chip for measurement.
(b) Conceptual diagram of V-trench biosensor combining two conventional prisms to be rotated and assembled, at the time of its conception
(c) Cross section of the developed V-trench biosensor chip

Makoto FUJIMAKI

Electronics and Photonics Research Institute

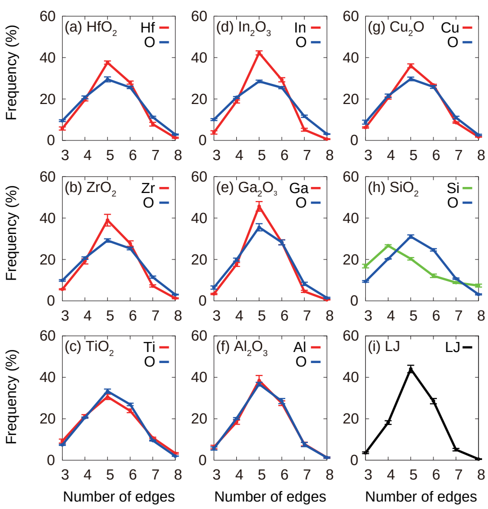
m-fujimaki@aist.go.jp

AIST TODAY Vol.14 No.6 p.15 (2014)

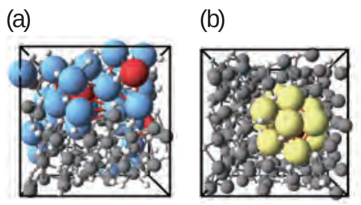
Universal medium-range order of amorphous metal oxides

Expected contribution to the rational design of insulation films, transparent electrodes, etc.

We proposed that the structure of amorphous metal oxides can be regarded as a dual-dense-random-packing structure, which is a superposition of the dense random packing of metal atoms and that of oxygen atoms. Our ab initio molecular dynamics simulations show that the medium-range order of amorphous TiO_2, ZrO_2, HfO_2, Cu_2O, Al_2O_3, Ga_2O_3, and In_2O_3 is characterized by the pentagonal-bipyramid arrangement of metal atoms and that of oxygen atoms, and prove the validity of our dual-random-sphere-packing model. In other words, we found that the pentagonal medium-range order is universal and independent of the type of metal oxide.



(a) to (g) distribution of the number of edges in a Voronoi face of metal and oxygen in the amorphous metal oxides
For comparison, results for (h) amorphous SiO_2, and for (i) an amorphous structure, in which particles interact through Lennard-Jones potential, are shown.



Icosahedral arrangements in amorphous Al_2O_3 obtained by the first-principles calculation
Large colored spheres show the icosahedral arrangement of (a) aluminum atoms and (b) oxygen atoms.

Kengo NISHIO
k-nishio@aist.go.jp

Hisao NAKAMURA
hs-nakamura@aist.go.jp

Takehide MIYAZAKI
takehide.miyazaki@aist.go.jp

Nanosystem Research Institute

AIST TODAY Vol.14 No.4 p.16 (2014)