Supporting Information

Supplementary information for In_2O_3-based low fluorescence transparent conducting film

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The resistivity after annealing

Figure S1 shows the resistivity after annealing In_2O_3 film annealed in an Ar/H_2 atmosphere at 600 °C. In the case of Ar/H_2 annealing, The resistivities were not dependent on the resistivity of as-deposited films, and it was 1-3 $\times 10^{-3}$ Ω· cm. This was probably because the amount of oxygen in the film had reached a state of thermal equilibrium in this atmosphere.

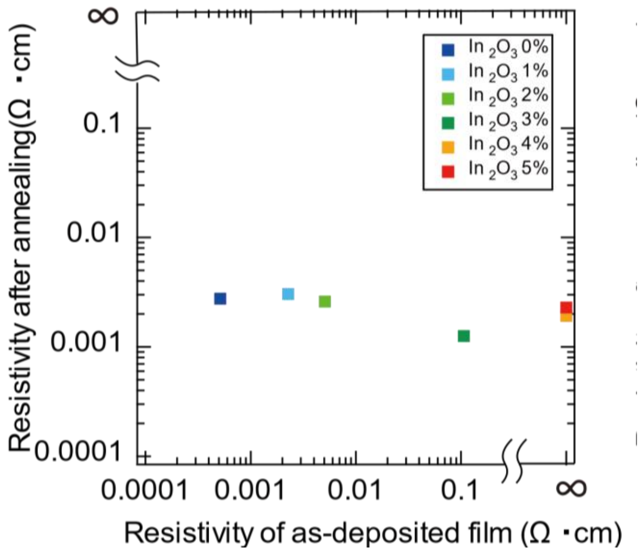

Figure. S1 The resistivityof In2O3 film before and after annealing in Ar/H2 atomosphere.

PL spectra of fluorescence points in annealed films

In Fig. 4, we showed an example of a spectrum of a fluorescent point in In_2O_3 film annealed in an Ar/H_2 atmosphere at 600°C. Figure S2(a) shows the spectra of a different fluorescent point. All of the fluorescence points were around 600 nm in similar spectra. The defects formed are considered to be the same in these fluorescent points, and these defects are considered to be oxygen vacancies. However, if the sample is annealed in an O_2 atmosphere, then the measured spectra are different. This means that the defects formed are different in these fluorescent points. It is considered that the fluorescence is caused by defects, such as interstitial oxygen or antisite oxygen, of which the concentration increases with the oxygen partial pressure.

The fluorescent point was observed in the annealed film, and high-temperature annealing was determined to be an unsuitable process for the formation of non-fluorescent films.

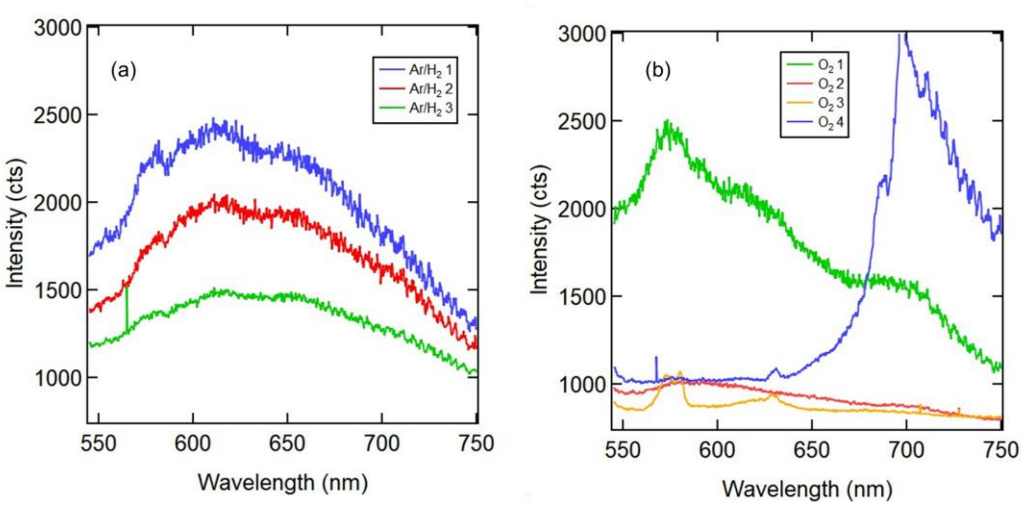

Figure. S2 PL spectra of different fluorescent point in In_2O_3 film annealed in (a) Ar/H_2 and (b) O_2.

The properties of a single NV center

Figure S3 shows the time-intensity second-order correlation functions $g^{(2)}(\tau)$ of a single NV center used in Figure 3(a) and (b). The intensity measured by APD was around 10 kcps. The measured $g^{(2)}(0)$ value is smaller than 0.5, indicating a single photon emitter.

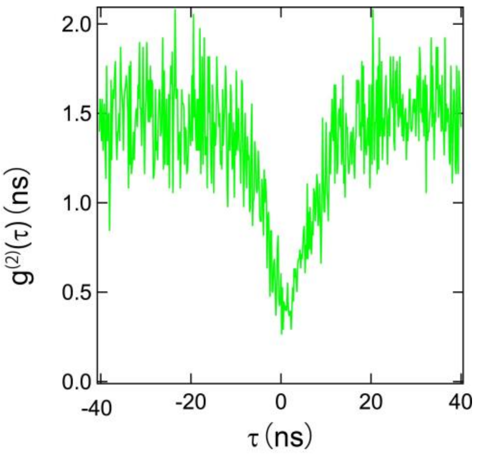

Figure. S3 The time-intensity second-order correlation functions $g^{(2)}(\tau)$ of single NV center