Claims

[Claim 1]

A fluorescent diamond comprising an MV center at a concentration of 1 x 10^{14}/cm^3 or higher, wherein M represents a metal or metalloid selected from Si, Ge, Sn, and Pb~~actinoid elements, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Al, Ga, In, Pb, B, Si, Ge, Sn, P, As, Sb, Bi, Se and Te~~, and V represents a vacancy,
wherein a diameter of the fluorescent diamond ranges approximately from 2 to 500 nm, and

wherein zero phonon line (ZPL) is 738nm when M is Si and

wherein the fluorescent diamond satisfies (i), (ii), (iii) and (iv):

(i) having a ratio of the number of vacancies to be introduced to the number of atoms of the metal or metalloid of from 0.1 to 10000 (number of V/number of M);

(ii) containing from 0.0001 to 1 atomic % of the metal or metalloid (M);

(iii) having a concentration of nitrogen-vacancy centers of 1 x 10^{17}/cm^3 or lower; and

(iv) having a density of vacancies **to be introduced** from 1 x 10^{16}/cm^3 to 3 x 10^{21}/cm^3.

~~[Claim 2]~~

~~The fluorescent diamond according to claim 1, satisfying at least one of (i), (ii), or (iii):~~

~~(i) having a ratio of the number of vacancies to be introduced to the number of atoms of the metal or metalloid of from 0.1 to 10000 (number of V/number of M);~~

~~(ii) containing from 0.0001 to 1 atomic % of the metal or metalloid (M); or~~

~~(iii) having a concentration of NV centers of 1 x $10^{17}/cm^3$ or lower.~~

[Claim ~~3~~2]

The fluorescent diamond according to claim 1~~ or 2~~, wherein the metal or metalloid element is Si, Ge, or Sn.

[Claim ~~4~~3]

The fluorescent diamond according to claim 1 or 2, wherein the metalloid element is Si.

[Claim 4~~5~~]

The fluorescent diamond according to any one of claims 1 to ~~4~~3, comprising a metal or metalloid element other than the metal or metalloid element constituting the MV center.

[Claim 5~~6~~]

The fluorescent diamond according to claim 4~~5~~, wherein the metal or metalloid element other than the metal or metalloid element constituting the MV center is Fe, Co, or Ni.

[Claim ~~7~~6]

A method of producing the fluorescent diamond comprising an MV center at a concentration of 1 x $10^{14}/cm^3$ or higher, wherein M represents Si, Ge, Sn, or Pb, and V represents a vacancy,

wherein a diameter of the fluorescent diamond ranges approximately from 2 to 500 nm,

wherein zero phonon line (ZPL) is 738nm when M is Si,

and wherein the method of producing the fluorescent diamond comprises a first stage and a second stage:

the first stage: introducing a proper concentration of a metal or metalloid (M) selected from Si, Ge, Sn, or Pb, in a process of diamond synthesis so as to provide a diamond comprising the metal or metalloid (M); and

the second stage: irradiating the diamond comprising the metal or metalloid (M) with a high energy beam to form a vacancy, and subsequently annealing the diamond so as to form an MV center emitting fluorescence;

wherein the fluorescent diamond satisfies (i), (ii), (iii) and (iv):

(i) having a ratio of the number of vacancies to be introduced to the number of atoms of the metal or metalloid of from 0.1 to 10000 (number of V/number of M);

(ii) containing from 0.0001 to 1 atomic % of the metal or metalloid (M);

(iii) having a concentration of nitrogen-vacancy centers of 1 x 10^{17}/cm^3 or lower; and

(iv) having a density of vacancies **to be introduced** from 1 x 10^{16}/cm^3 to 3 x 10^{21}/cm^3.

~~A method of producing the fluorescent diamond described in any one of claims 1 to 6, comprising a first stage and a second stage:~~

~~the first stage: introducing a proper concentration of a metal or metalloid (M) in a process of diamond synthesis so as to provide a diamond comprising the metal or metalloid (M); and~~

~~the second stage: irradiating the diamond comprising the metal or metalloid (M) with a high energy beam to form a vacancy, and subsequently annealing the diamond so as to form an MV center emitting fluorescence.~~

[Claim 7~~8~~]

The method of producing the fluorescent diamond according to claim 6~~7~~, wherein the high energy beam is an ion beam of He or H, or an electron beam.

[Claim 8~~9~~]

The method of producing the fluorescent diamond according to claim 7, wherein in the first stage, a metal or metalloid other than the metal or metalloid element constituting the MV center is present.

[Claim ~~10~~9]

The method of producing the fluorescent diamond according to claim ~~9~~8, wherein the metal or metalloid other than the metal or metalloid element constituting the MV center is Fe, Co, or Ni.

[Claim ~~11~~10]

The method of producing the fluorescent diamond according to any one of claims ~~7~~ 6 to ~~10~~9, wherein a method for the diamond synthesis in the first stage is a chemical vapor deposition method (CVD method).

[Claim ~~12~~11]

The method of producing the fluorescent diamond according to any one of claims ~~7~~ 6 to ~~10~~9, wherein the method for the diamond synthesis in the first stage is a detonation method.

[Claim ~~13~~12]

The method for producing a fluorescent diamond according to any one of claims ~~7~~ 6 to ~~10~~9, wherein the method for the diamond synthesis in the first stage is an implosion method.