Claims

[Claim 1]

A method for producing a nanodiamond doped with a Group 14 element selected from the group consisting of Si, Ge, Sn, and Pb, the method comprising:
subjecting a nanodiamond composition to an alkali treatment to remove the Group 14 element and/or oxide thereof, wherein the nanodiamond composition comprises a nanodiamond doped with the Group 14 element, and a Group 14 element and/or an oxide thereof, and
further subjecting a post treatment including gas-phase oxidation, wherein the gas-phase oxidation temperature is 300°C or higher, and the gas-phase oxidation time is 2 hours or longer, and

wherein the nanodiamond doped with a Group 14 element obtained by the method has a ratio (H/D) of a peak area (H) of a surface hydroxy group (OH) to a peak area (D) of diamond by Raman spectroscopy of from 0.1 to 5, and a ratio (C/D) of a peak area (C) of a surface carbonyl group (CO) to a peak area (D) of diamond by Raman spectroscopy of from 0.01 to 1.5.

[Claim 2]

The method for producing a nanodiamond doped with a Group 14 element according to claim 1, the method further comprising:

detonating by exploding an explosive composition containing at least one explosive and at least one Group 14 element compound in a sealed container to obtain a nanodiamond doped with at least one Group 14 element selected from the group consisting of Si, Ge, Sn, and Pb before the alkali treatment to remove the Group 14 element and/or oxide thereof.

[Claim 3]

The method for producing a nanodiamond doped with a Group 14 element according to claim 1 or 2, further including treating the nanodiamond doped with the Group 14 element with a mixed acid of concentrated nitric acid and concentrated sulfuric acid before or after the alkali treatment.

[Claim 4]

The method for producing a nanodiamond doped with a Group 14 element according to claim2 or 3, wherein the explosive composition further comprises a compound comprising at least one third element selected from the group consisting of B, P, S, Cr, Al, Li, Na, K, Cs, Mg, Ca, Sr, Ba, Ti, Zr, V, Nb, Ta, Mo, W, Mn, Fe, Ni, Cu, Ag, Zn, Cd, Hg, Ga, In, Tl, As, Sb, Bi, Se, Te, Co, Xe, F, Y, and lanthanoids.

[Claim 5]

A method for purifying a nanodiamond doped with a Group 14 element selected from the group consisting of Si, Ge, Sn, and Pb, the method comprising:
subjecting a nanodiamond composition to an alkali treatment, wherein the nanodiamond composition comprises a nanodiamond doped with at least one Group 14 element, and a Group 14 element and/or oxide thereof,

wherein the Group 14 element and/or oxide thereof are removed from the nanodiamond composition by the alkali treatment; and
further subjecting a post treatment including gas-phase oxidation, wherein the gas-phase oxidation temperature is 300°C or higher, and the gas-phase oxidation time is 2 hours or longer, and

wherein the nanodiamond doped with a Group 14 element obtained by the method has a ratio (H/D) of a peak area (H) of a surface hydroxy group (OH) to a peak area (D) of diamond by Raman spectroscopy of from 0.1 to 5, and a ratio (C/D) of a peak area (C) of a surface carbonyl group (CO) to a peak area (D) of diamond by Raman spectroscopy of from 0.01 to 1.5.

[Claim 6]

The method for purifying a nanodiamond doped with a Group 14 element according to claim 5, wherein the nanodiamond composition is obtained by mixed acid treatment.

[Claim 7]
The method for purifying a nanodiamond doped with a Group 14 element according to claim5 or 6, wherein the nanodiamond composition further comprising at least one third element selected from the group consisting of B, P, S, Cr, Al, Li, Na, K, Cs, Mg, Ca, Sr, Ba, Ti, Zr, V, Nb, Ta, Mo, W, Mn, Fe, Ni, Cu, Ag, Zn, Cd, Hg, Ga, In, Tl, As, Sb, Bi, Se, Te, Co, Xe, F, Y, and lanthanoids, and/or oxide thereof.

[Claim 8]

The method for purifying a nanodiamond doped with a Group 14 element according to any one of claims5 to 7, wherein the nanodiamond is further doped with at least one third element selected from the group consisting of B, P, S, Cr, Al, Li, Na, K, Cs, Mg, Ca, Sr, Ba, Ti, Zr, V, Nb, Ta, Mo, W, Mn, Fe, Ni, Cu, Ag, Zn, Cd, Hg, Ga, In, Tl, As, Sb, Bi, Se, Te, Co, Xe, F, Y, and lanthanoids.