CLAIMS

1. A process of treating an implant, the process comprising the following step:
- treating the surface of the implant with at least one phosphonic acid compound or a pharmaceutically acceptable salt, ester or amide thereof under sonication at a temperature of about 50°C to about 90°C.

2. The process of claim 1, wherein the step of treatment with the phosphonic acid compound is conducted under sonication at a temperature of about 60°C to about 70°C.

3. The process of claim 1 or 2, wherein the process further comprises, before the step of treatment with the phosphonic acid compound, a step of pre-treating the surface of the implant with a cleaning agent,
wherein the cleaning agent is a 0.5% (v/v) to 5% (v/v) aqueous solution of an alkaline phosphate-free liquid concentrate, wherein the liquid concentrate has a pH greater than 12 and comprises about 5% (w/w) to about 15% (w/w) of methylglycinediacetate and about 1% (w/w) to about 5% (w/w) of an inorganic base, and wherein said 0.5% (v/v) to 5% (v/v) aqueous solution has a pH equal to or greater than 11.

4. The process of claim 3, wherein the step of pre-treatment with the cleaning agent is conducted at a temperature of about 50°C to about 90°C.

5. The process of claim 3 or 4, wherein the step of pre-treatment with the cleaning agent is conducted under sonication.

6. The process of any one of claims 1 to 5, wherein the phosphonic acid compound is a C_{1-30} hydrocarbon which is substituted with 1 to 6 phosphonic acid groups, wherein said hydrocarbon is optionally substituted with one or more groups independently selected from hydroxy and halogen, and further wherein one or more carbon atoms comprised in said hydrocarbon are optionally each replaced by a heteroatom independently selected from nitrogen, oxygen and sulfur.

7. The process of any one of claims 1 to 6, wherein the phosphonic acid compound is a C_{1-15} hydrocarbon which is substituted with 1 to 6 phosphonic acid groups.

8. The process of claim 6 or 7, wherein said hydrocarbon is substituted with 3 to 6 phosphonic acid groups.

9. The process of any one of claims 1 to 8, wherein the phosphonic acid compound is a C_{1-10} alkane which is substituted with 3 to 6 phosphonic acid groups.

10. The process of any one of claims 1 to 9, wherein the phosphonic acid compound is a linear C_{2-6} alkane which is substituted with 3 or 4 phosphonic acid groups.

11. The process of any one of claims 1 to 6, wherein the phosphonic acid compound is selected from methanephosphonic acid, ethanephosphonic acid, propane-1-phosphonic acid, propane-2-phosphonic acid, methane-1,1-diphosphonic acid, ethane-1,1-diphosphonic acid, ethane-1,2-diphosphonic acid, propane-1,1-diphosphonic acid, propane-2,2-diphosphonic acid, propane-1,2-diphosphonic acid, propane-1,3-diphosphonic acid, ethane-1,1,1-triphosphonic acid, ethane-1,1,2-triphosphonic acid, propane-1,1,1-triphosphonic acid, propane-1,1,2-triphosphonic acid, propane-1,1,3-triphosphonic acid, propane-1,2,2-triphosphonic acid, propane-1,2,3-triphosphonic acid, butane-1,1,1-triphosphonic acid, butane-1,1,2-triphosphonic acid, butane-1,1,3-triphosphonic acid, butane-1,1,4-triphosphonic acid, butane-1,2,2-triphosphonic acid, butane-2,2,3-triphosphonic acid, butane-1,3,3-triphosphonic acid, butane-1,2,3-triphosphonic acid, butane-1,2,4-triphosphonic acid, pentane-1,1,5-triphosphonic acid, pentane-2,2,5-triphosphonic acid, hexane-1,1,6-triphosphonic acid, hexane-2,2,6-triphosphonic acid, propane-1,1,1,2-tetraphosphonic acid, propane-1,1,1,3-tetraphosphonic acid, propane-1,1,2,2-tetraphosphonic acid, propane-1,1,2,3-tetraphosphonic acid, propane-1,1,3,3-tetraphosphonic acid, propane-1,2,2,3-tetraphosphonic acid, butane-1,1,4,4-tetraphosphonic acid, pentane-1,1,5,5-tetraphosphonic acid, hexane-1,1,6,6-tetraphosphonic acid, heptane-1,4,4,7-tetraphosphonic acid, octane-1,4,4,8-tetraphosphonic acid, nonane-1,5,5,9-tetraphosphonic acid, pentane-1,1,3,5,5-pentaphosphonic acid, pentane-1,1,2,4,5,5-hexaphosphonic acid, tert-butyl phosphonic acid, 2-methyl-propane-1,1,1-triphosphonic acid, 2-methyl-propane-1,1,3-triphosphonic acid, 2-(phosphono-methyl)-propane-1,3-diphosphonic acid, 2-methyl-propane-1,1,3,3-tetraphosphonic acid, 2-methyl-butane-1,1,1-triphosphonic acid, 3-methyl-butane-1,1,1-triphosphonic acid, 2-(phosphono-methyl)-propane-1,1-diphosphonic acid, 2-methyl-butane-1,1,3-triphosphonic acid, 2-methyl-butane-1,1,4-triphosphonic acid, 3-methyl-butane-2,2,4-triphosphonic acid, 3-methyl-butane-1,1,4-triphosphonic acid, 2-(phosphono-methyl)-butane-1,3-diphosphonic acid, 2-(phosphono-methyl)-butane-1,4-diphosphonic acid, 3-methyl-butane-1,1,2-triphosphonic

acid, 2-methyl-butane-1,1,4,4-tetraphosphonic acid, 2-methyl-pentane-1,1,1-triphosphonic acid, 2-(phosphono-methyl)-pentane-1,1-diphosphonic acid, 2-methyl-pentane-1,1,3-triphosphonic acid, 2-methyl-pentane-1,1,4-triphosphonic acid, 2-methyl-pentane-1,1,5-triphosphonic acid, 2-methyl-pentane-1,3,3-triphosphonic acid, 4-methyl-pentane-2,2,5-triphosphonic acid, 4-methyl-pentane-1,1,5-triphosphonic acid, 2-(phosphono-methyl)-pentane-1,3-diphosphonic acid, 2-methyl-pentane-1,3,4-triphosphonic acid, 2-(phosphono-methyl)-pentane-1,4-diphosphonic acid, 2-(phosphono-methyl)-pentane-1,5-diphosphonic acid, 2-methyl-pentane-1,3,5-triphosphonic acid, 4-methyl-pentane-1,2,5-triphosphonic acid, 2-methyl-pentane-1,1,5,5-tetraphosphonic acid, 3-methyl-pentane-1,1,1-triphosphonic acid, 3-methyl-pentane-1,1,2-triphosphonic acid, 3-(phosphono-methyl)-pentane-1,1-diphosphonic acid, 3-methyl-pentane-1,1,5-triphosphonic acid, 3-(triphosphono-methyl)-pentane, 3-(phosphono-methyl)-pentane-1,5-diphosphonic acid, 3-methyl-pentane-2,2,5-triphosphonic acid, 2-methyl-hexane-1,1,1-triphosphonic acid, 2-(phosphono-methyl)-hexane-1,6-diphosphonic acid, 2-methyl-hexane-1,1,6,6-tetraphosphonic acid, 4-methyl-heptane-1,1,1-triphosphonic acid, 4-methyl-heptane-1,1,6,6-tetraphosphonic acid, 2-methyl-octane-1,1,1-triphosphonic acid, 2-methyl-octane-1,1,8,8-tetraphosphonic acid, 3-(bisphosphono-methyl)-butane-1,1,4,4-tetraphosphonic acid, 3-(bisphosphono-methyl)-pentane-1,1,5,5-tetraphosphonic acid, diethylenetriamine penta(methylene phosphonic acid), vinyl phosphonic acid, 1-propene-3-phosphonic acid, 2-propene-3-phosphonic acid, 1-propene-2-phosphonic acid, ethene-1,1-diphosphonic acid, ethene-1,2-diphosphonic acid, 1-propene-1,1-diphosphonic acid, 1-propene-3,3-diphosphonic acid, 1-propene-1,2-diphosphonic acid, 1-propene-2,3-diphosphonic acid, 1-propene-1,3-diphosphonic acid, 1-ethene-1,1,2-triphosphonic acid, 1-propene-3,3,3-triphosphonic acid, 1-propene-1,1,2-triphosphonic acid, 1-propene-2,3,3-triphosphonic acid, 1-propene-1,1,3-triphosphonic acid, 1-propene-1,3,3-triphosphonic acid, 1-propene-1,2,3-triphosphonic acid, 1-butene-4,4,4-triphosphonic acid, 2-butene-4,4,4-triphosphonic acid, 1-butene-1,1,2-triphosphonic acid, 2-butene-3,4,4-triphosphonic acid, 1-butene-3,4,4-triphosphonic acid, 1-butene-1,1,3-triphosphonic acid, 2-butene-1,1,3-triphosphonic acid, 1-butene-2,4,4-triphosphonic acid, 1-butene-1,1,4-triphosphonic acid, 2-butene-1,1,4-triphosphonic acid, 1-butene-1,4,4-triphosphonic acid, 1-butene-3,3,4-triphosphonic acid, 1-butene-2,3,3-triphosphonic acid, 1-butene-1,3,3-triphosphonic acid, 1-butene-1,2,3-triphosphonic acid, 2-butene-2,3,4-triphosphonic acid, 1-butene-2,3,4-triphosphonic acid, 1-butene-1,2,4-triphosphonic acid, 2-butene-1,2,4-triphosphonic acid, 1-butene-1,3,4-triphosphonic acid, 2-pentene-1,1,5-triphosphonic acid, 2-pentene-1,5,5-triphosphonic acid, 1-pentene-1,5,5-triphosphonic acid, 2-pentene-1,4,4-triphosphonic acid, 1-pentene-1,4,4-triphosphonic acid, 1-hexene-1,1,6-triphosphonic acid, 2-hexene-1,1,6-triphosphonic acid, 3-hexene-1,1,6-triphosphonic acid, 2-hexene-1,6,6-triphosphonic

acid, 1-hexene-1,6,6-triphosphonic acid, 1-hexene-1,5,5-triphosphonic acid, 2-hexene-1,5,5-triphosphonic acid, 3-hexene-2,2,6-triphosphonic acid, 1-propene-2,3,3,3-tetraphosphonic acid, 1-propene-1,3,3,3-tetraphosphonic acid, 1-propene-1,2,3,3-tetraphosphonic acid, 1-propene-1,1,3,3-tetraphosphonic acid, 1-butene-1,1,4,4-tetraphosphonic acid, 2-butene-1,1,4,4-tetraphosphonic acid, 1-pentene-1,1,5,5-tetraphosphonic acid, 2-pentene-1,1,5,5-tetraphosphonic acid, 1-hexene-1,1,6,6-tetraphosphonic acid, 2-hexene-1,1,6,6-tetraphosphonic acid, 3-hexene-1,1,6,6-tetraphosphonic acid, 1-heptene-1,4,4,7-tetraphosphonic acid, 2-heptene-1,4,4,7-tetraphosphonic acid, 1-octene-1,4,4,8-tetraphosphonic acid, 2-octene-1,4,4,8-tetraphosphonic acid, 3-octene-1,5,5,8-tetraphosphonic acid, 1-nonene-1,5,5,9-tetraphosphonic acid, 2-nonene-1,5,5,9-tetraphosphonic acid, 3-nonene-1,5,5,9-tetraphosphonic acid, 1-cyclopentyl-phosphonic acid, 1,1-cyclopentyl-diphosphonic acid, 1,2-cyclopentyl-diphosphonic acid, 1,3-cyclopentyl-diphosphonic acid, 1-cyclohexyl-phosphonic acid, 1,1-cyclohexyl-diphosphonic acid, 1,2-cyclohexyl-diphosphonic acid, 1,3-cyclohexyl-diphosphonic acid, 1,4-cyclohexyl-diphosphonic acid, and phenyl-1-phosphonic acid.

12. The process of any one of claims 1 to 11, wherein the phosphonic acid compound is propane-1,1,3,3-tetraphosphonic acid.

13. The process of any one of claims 1 to 5, wherein the phosphonic acid compound is a bisphosphonic acid.

14. The process of claim 13, wherein the bisphosphonic acid is selected from etidronic acid, clodronic acid, alendronic acid, tiludronic acid, neridronic acid, olpadronic acid, risedronic acid, pamidronic acid, ibandronic acid, zoledronic acid, incadronic acid, minodronic acid, and EB-1053.

15. The process of any one of claims 1 to 5, wherein the phosphonic acid compound is an amino acid which is substituted with 1 to 6 phosphonic acid groups, or the phosphonic acid compound is a peptide of 2 to 15 amino acid residues, which is substituted with 1 to 6 phosphonic acid groups.

16. The process of any one of claims 1 to 15, wherein the implant is a dental abutment, a coronary stent, a dental implant, a hip implant, a spinal implant, a small joints implant, a shoulder implant, or a knee implant.

17. The process of any one of claims 1 to 16, wherein the surface of the implant is made of titanium, chromium, niobium, tantalum, vanadium, zirconium, aluminum, cobalt, nickel, stainless steel, or an alloy of any of the aforementioned metals.

18. The process of any one of claims 1 to 17, wherein the surface of the implant is made of titanium or a titanium alloy.

19. The process of any one of claims 1 to 18, wherein the surface of the implant is made of grade 4 titanium, Ti-6Al-4V alloy, Ti-6Al-4V ELI alloy, a titanium-niobium alloy, or a titanium-zirconium alloy.

20. The process of any one of claims 1 to 17, wherein the surface of the implant is made of a cobalt-chromium alloy.

21. The process of any one of claims 1 to 16, wherein the surface of the implant is made of a ceramic which is an oxide, a carbide, a nitride, an oxynitride, a carbonitride, or an oxycarbide of a metal or of a metal alloy, wherein said metal or metal alloy is selected from titanium, chromium, niobium, tantalum, vanadium, zirconium, aluminum, cobalt, nickel, stainless steel, and alloys thereof.