What is claimed is:

1. A method of upgrading an oil feedstock comprising:

obtaining a quantity of the oil feedstock, wherein the oil feedstock comprises carbon and hydrogen content, the oil feedstock further comprising metal, sulfur and/or nitrogen content;

reacting the quantity of the oil feedstock with an alkali metal and a radical capping substance, wherein the alkali metal reacts with the metal, sulfur or nitrogen content to form one or more inorganic products, wherein the radical capping substance reacts with the carbon and hydrogen content to form a hydrocarbon phase; and

separating the inorganic products from the hydrocarbon phase.

2. The method of claim 1, wherein the oil feedstock comprises one or more of the following: petroleum, heavy oil, extra heavy oil, bitumen, shale oil, natural gas, petroleum gas, methane, methyl mercaptan, hydrogen sulfide, refinery streams such as vacuum gas oil, fluidized catalytic cracker (FCC) feed, dimethyl disulfide, and near product streams (such as diesel).

3. The method of claim 1, wherein the radical capping substance comprises one or more of the following: methane, ethane, propane, butane, pentane, hexane, heptane, octane, ethene, propene, butane, pentene, hexene, heptene, octene, and isomers of the foregoing, natural gas, shale gas, liquid petroleum gas, ammonia, primary, secondary, and tertiary ammines, thiols, mercaptans, and hydrogen sulfide.

4. The method of claim 1, wherein the reacting the quantity of the oil feedstock with the alkali metal and the radical capping substance occurs in the temperature range from 98 °C – 500 °C.

5. The method of claim 1, wherein the reacting the quantity of the oil feedstock with the alkali metal and the radical capping substance occurs in the pressure range of 500 psi – 3000 psi.

6. The method of claim 1, further comprising:

electrochemically regenerating the alkali metal from the inorganic products.

7. The method of claim 1, wherein the separating occurs in a separator, wherein the inorganic products form a phase that is separable from the hydrocarbon phases.

8. The method of claim 1, wherein the reacting the quantity of the oil feedstock with an alkali metal and a radical capping substance forms hydrogen in situ.

9. The method of claim 8, wherein the radical capping substance comprises natural gas containing quantities of H_2S.

10. The method of claim 1, wherein the API gravity of the hydrocarbon phase is greater than the API gravity of the oil feedstock.

11. The method as in claim 1, wherein hydrocarbon phase has a greater energy value than the oil feedstock.

12. A reactor comprising:

quantity of the oil feedstock, wherein the oil feedstock comprises carbon and hydrogen content, the oil feedstock further comprising metal, sulfur or nitrogen content;

an alkali metal;

a radical capping substance; and

wherein the alkali metal reacts with the metal, sulfur or nitrogen content to form one or more inorganic products, wherein the radical capping substance reacts with the carbon and hydrogen content to form a hydrocarbon phase.

13. The reactor of claim 12, wherein hydrogen gas is not added to the reactor.

14. The reactor of claim 12 wherein the radical capping substance comprises natural gas containing quantities of H_2S.

CLAIMS

1. A method of upgrading an oil feedstock comprising:

obtaining a quantity of the oil feedstock, wherein the oil feedstock comprises carbon and hydrogen content, the oil feedstock further comprising metal, sulphur and/or nitrogen content;

reacting the quantity of the oil feedstock with an alkali metal and a radical capping substance, wherein the alkali metal reacts with the metal, sulfur or nitrogen content to form one or more inorganic products, wherein the radical capping substance reacts with the carbon and hydrogen content to form a hydrocarbon phase; wherein the radical capping substance comprises one or more of the following: ammonia; primary, secondary and tertiary amines; thiols; mercaptans; and hydrogen sulfide; and

separating the inorganic products from the hydrocarbon phase.

2. The method of claim 1, wherein the oil feedstock comprises one or more of the following: petroleum, heavy oil, extra heavy oil, bitumen, shale oil, natural gas, petroleum gas, methane, methyl mercaptan, hydrogen sulfide, refinery streams such as vacuum gas oil, fluidized catalytic cracker (FCC) feed, dimethyl disulfide, and near product streams (such as diesel).

3. The method of any preceding claim, wherein the reacting the quantity of the oil feedstock with the alkali metal and the radical capping substance occurs in the temperature range from 98 °C – 500 °C.

4. The method of any preceding claim, wherein the reacting the quantity of the oil feedstock with the alkali metal and the radical capping substance occurs in the pressure range of 500 psi – 3000 psi.

5. The method of any preceding claim, further comprising:

electrochemically regenerating the alkali metal from the inorganic products.

6. The method of claim 1, wherein hydrogen sulfide (H_2S) or ammonia (NH_3) is used as part of the radical capping substance and the reacting the quantity of the oil feedstock with an alkali metal and a radical capping substance forms hydrogen in situ.

7. The method of claim 6, wherein the radical capping substance comprises natural gas containing quantities of H_2S.