Claims:

1. A semi-conducting biogenic hybrid catalyst capable of reducing CO_2 into fuel precursors, said catalyst consisting:

   (a) electroactive microorganism selected from the group consisting of *Enterobacter aerogenes* MTCC 25016, *Serratia sp.* MTCC 25017, *Shewanella sp.* MTCC 25020, *Alcaligenes sp.* MTCC 25022, *Pseudomonas aeruginosa* MTCC 1036, *Ochrobactrum anthropi* ATCC 49188, *Ochrobactrum anthropi* MTCC 9026, and *Pseudomonas alcaliphila* MTCC 6724; and

   (b) semi conducting particles comprising a precursor metal component, electron facilitator and dye molecule;

   wherein the semi conducting particles are located on cell surface of the electroactive microorganisms.

2. A method for bio-assisted conversion of CO_2 to fuel precursors employing the semiconducting biogenic hybrid catalyst as claimed in claim 1, said method comprising:

   (a) adding the semi-conducting biogenic hybrid catalyst as claimed in claim 1 to culture medium in a transparent reactor;

   (b) sparging CO_2 through the culture medium and irradiating the transparent reactor with a light source having wavelength >400 nm; and

   (c) recovering the fuel precursors from the culture medium;

   wherein the fuel precursors are selected from the group consisting of methanol, ethanol, acetic acid, butanol, isopropanol, butyric acid, and caproic acid.

3. A method for bio-assisted conversion of biogas to fuel precursors employing the semiconducting hybrid catalyst as claimed in claim 1, said method comprising:

   (a) adding the semi-conducting biogenic hybrid catalyst as claimed in claim 1 to culture medium in a glass column;

   (b) sparging biogas through the culture medium and irradiating the glass column with a light source having wavelength >400 nm; and

(c) recovering the fuel precursors from the culture medium;

wherein the fuel precursors comprise a mixture of methanol, ethanol, and acetic acid.

4. A process for synthesizing a semiconductor biogenic-hybrid catalyst, said process comprising:

(a) selectively culturing electroactive microorganisms selected from the group consisting of *Enterobacter aerogenes* MTCC 25016, *Serratia sp.* MTCC 25017, *Shewanella sp.* MTCC 25020, *Alcaligenes sp.* MTCC 25022, *Pseudomonas aeruginosa* MTCC 1036, *Ochrobactrum anthropi* ATCC 49188, *Ochrobactrum anthropi* MTCC 9026, and *Pseudomonas alcaliphila* MTCC 6724;

(b) mixing at least a salt, at least one 2D material, and an electron facilitator, in presence of a surface directing agent to obtain a semiconducting hybrid solution;

(c) adding the semiconducting hybrid solution of step (b) to the electroactive microorganism culture of step (a) to obtain an initiator culture;

(d) providing counter ion precursor to the initiator culture of step (c); and

(e) separating the semiconductor biogenic-hybrid catalyst from the culture;

wherein the salt is selected from the group consisting of $CuCl_2$, $CdCl_2$, $ZnCl_2$, $ZnBr_2$, $GaCl_3$, $InCl_3$, $FeCl_2$, $FeCl_3$, $SnCl_2$, $SnCl_4$, $Cd(NO_3)_2$, $Ga(NO_3)_3$, $Ln(NO_3)_3$, $Zn(NO_3)_2$, $Fe(NO_3)_3$, $CdCO_3$, $CdSO_4$, $FeSO_4$, $ZnSO_4$, Fe_2O_3, CdO, Ga_2O_3, Ln_2O_3, ZnO, SnO, SnO_2, $Fe(OH)_3$, $Zn(OH)_2$, FeOOH, FeO(OH), $Cd(CH_3COO)_2$, Iron perchlorate, Copper perchlorate, Copper EDTA complex, Nickel alkylamine complex, Iron piperidine complex, Cadmium pyridine complex, Iron bipyridine salt and Iron acac complex;

wherein the 2D material is selected from the group consisting of graphene, porous graphene, gC_3N_4, single walled CNT, MoS_2, WS_2, SnS_2, phosphorene, graphene nanoparticles, TiC, and borophene;

wherein the electron facilitator is selected from the group consisting of neutral red, azo-dyes, Iron porphyrin complex, Schiff base complex, multi walled CNT, Cd (II) or Cu (II) imidazole complex, and Ruthenium complex;

wherein the surface directing agent is selected from the group consisting of Tween, sodium lauryl sulfate, p-172, Lauryl dimethyl amine oxide, Cetyltrimethylammonium bromide, Polyethoxylated alcohol, Polyoxyethylene sorbitan Octoxynol (Triton X100), N, N-dimethyldodecylamine-N-oxide, Hexadecyltrimethylammonium bromide, Polyoxyl 10 lauryl ether , Brij 721, sodium deoxycholate, sodium cholate, Polyoxyl castor oil (Cremophor), Nonylphenol ethoxylate (Tergitol), Cyclodextrins, Lecithin, and Methylbenzethonium chloride (Hyamine); and

wherein the counter ion precursor is a gaseous material or an organosulfur compound.

5. The process as claimed in 4, wherein the gaseous material is selected from the group consisting of H_2S containing gas, industrial flue gas, and bio gas.

6. The process as claimed in claim 4, wherein the organosulfur compound is selected from the group consisting of methanethiol, ethanethiol, propanethiol, butanethiol, thiophenol, ethanedithiol, 1,3ropanedithiol, 1,4 butanedithiol, thiophene, 2-mercaptoethanol, 3-mercaptopropanol, 4mercaptophenol, dithiothreitol, cysteine, homocysteine, methionine, thioserine, thiothreonine, thiotyrosine, glutathione, 2-thiouracil, 6-methyl-2-thiouracil, 4-thiouracil, 2,4dithiouracil, 2-thiocytosine, 5-methyl-2-thiocytosine, 5-fluoro-2-thiocytosine, 2-thiothymine, 4-thiothymine, 2,4-dithiothymine, 6-thioguanine, 8-thioadenine, 2- thioxanthine, 6-thioxanthine, 6-thiohypoxanthine, 6-thiopurine, dimethylsulfide, diethylsulfide, diphenylsulfide, biotin, cystine, lipoic acid, diphenyl disulfide, iron disulfide, 2- hydroxyethyldisulfide, thioacetic acid, trimethylsulfonium, diphenylmethylsulfonium chloride, dimethylsulfoxide, dimethylsulfone, thioketone, thioamide, thiocyanate, isothiocyanate, thiocarbamate, and dithiocarbamates.

Claims:

1. A semi-conducting biogenic hybrid catalyst capable of converting CO_2 into fuel precursors, said catalyst consisting:

   (a) electroactive microorganism selected from the group consisting of *Enterobacter aerogenes* MTCC 25016, *Serratia sp.* MTCC 25017, *Shewanella sp.* MTCC 25020, *Alcaligenes sp.* MTCC 25022, *Pseudomonas aeruginosa* MTCC 1036, *Ochrobactrum anthropi* ATCC 49188, *Ochrobactrum anthropi* MTCC 9026, and *Pseudomonas alcaliphila* MTCC 6724; and

   (b) semi conducting particles comprising

   a precursor metal component comprising a salt selected from the group consisting of $CuCl_2$, $CdCl_2$, $ZnCl_2$, $ZnBr_2$, $GaCl_3$, $InCl_3$, $FeCl_2$, $FeCl_3$, $SnCl_2$, $SnCl_4$, $Cd(NO_3)_2$, $Ga(NO_3)_3$, $Ln(NO_3)_3$, $Zn(NO_3)_2$, $Fe(NO_3)_3$, $CdCO_3$, $CdSO_4$, $FeSO_4$, $ZnSO_4$, Fe_2O_3, CdO, Ga_2O_3, Ln_2O_3, ZnO, SnO, SnO_2, $Fe(OH)_3$, $Zn(OH)_2$, FeOOH, FeO(OH), $Cd(CH_3COO)_2$, iron perchlorate, copper perchlorate, copper EDTA complex, nickel alkylamine complex, iron piperidine complex, cadmium pyridine complex, iron bipyridine salt and iron acac complex;

   at least one 2D material selected from the group consisting of graphene, porous graphene, gC_3N_4, single walled carbon nanotube (CNT), MoS_2, WS_2, SnS_2, phosphorene, graphene nanoparticles, TiC and borophene;

   an electron facilitator selected from the group consisting of neutral red, azo-dyes, iron porphyrin complex, schiff base complex, multi walled carbon nanotube (CNT), Cd (II) or Cu (II) imidazole complex, and ruthenium complex;

   a surface directing agent selected from the group consisting of polysorbate, sodium lauryl sulfate, Lauryl dimethyl amine oxide, Cetyltrimethylammonium bromide, Polyethoxylated alcohol, Polyoxyethylene sorbitan Octoxynol, N, N-dimethyldodecylamine-N-oxide, Hexadecyltrimethylammonium bromide, Polyoxyl 10 lauryl ether, sodium deoxycholate, sodium cholate, polyoxyl castor oil, nonylphenol ethoxylate, cyclodextrins, lecithin, and methylbenzethonium chloride; and

a counter ion precursor selected from a gaseous material or an organosulfur compound; wherein the semi conducting particles are present on the cell surface of the electroactive microorganism; and

wherein the fuel precursors are selected from the group consisting of methanol, ethanol, acetic acid, butanol, isopropanol, butyric acid, caproic acid and combination thereof.

2. The semi-conducting biogenic hybrid catalyst as claimed in claim 1, wherein the semi conducting particles comprises an electron facilitator neutral red.

3. The semi-conducting biogenic hybrid catalyst as claimed in claim 1, wherein the semi conducting particles comprises a surface directing agent selected from polysorbate, Lauryl dimethyl amine oxide, Polyethoxylated alcohol and sodium lauryl sulfate.

4. A method for bio-assisted conversion of CO_2 to fuel precursors employing the semiconducting biogenic hybrid catalyst as claimed in claim 1, said method comprising:

   (a) adding the semi-conducting biogenic hybrid catalyst as claimed in claim 1 to culture medium in a transparent reactor;

   (b) sparging CO_2 through the culture medium and irradiating the transparent reactor with a light source having wavelength >400 nm; and

   (c) recovering the fuel precursors from the culture medium;

   wherein the fuel precursors are selected from the group consisting of methanol, ethanol, acetic acid, butanol, isopropanol, butyric acid, and caproic acid.

5. A process for synthesizing a semiconductor biogenic-hybrid catalyst as claimed in claim 1, said process comprising:

   (a) culturing electroactive microorganisms selected from the group consisting of *Enterobacter aerogenes* MTCC 25016, *Serratia sp.* MTCC 25017, *Shewanella sp.* MTCC 25020, *Alcaligenes sp.* MTCC 25022, *Pseudomonas aeruginosa* MTCC 1036, *Ochrobactrum anthropi* ATCC 49188, *Ochrobactrum anthropi* MTCC 9026, and *Pseudomonas alcaliphila* MTCC 6724;

(b) mixing at least a salt, at least one 2D material, and an electron facilitator, in presence of a surface directing agent to obtain a semiconducting hybrid solution;

(c) adding the semiconducting hybrid solution of step (b) to the electroactive microorganism culture of step (a) to obtain an initiator culture;

(d) providing counter ion precursor to the initiator culture of step (c); and

(e) separating the semiconductor biogenic-hybrid catalyst from the culture;

wherein the salt is selected from the group consisting of $CuCl_2$, $CdCl_2$, $ZnCl_2$, $ZnBr_2$, $GaCl_3$, $InCl_3$, $FeCl_2$, $FeCl_3$, $SnCl_2$, $SnCl_4$, $Cd(NO_3)_2$, $Ga(NO_3)_3$, $Ln(NO_3)_3$, $Zn(NO_3)_2$, $Fe(NO_3)_3$, $CdCO_3$, $CdSO_4$, $FeSO_4$, $ZnSO_4$, Fe_2O_3, CdO, Ga_2O_3, Ln_2O_3, ZnO, SnO, SnO_2, $Fe(OH)_3$, $Zn(OH)_2$, FeOOH, FeO(OH), $Cd(CH_3COO)_2$, Iron perchlorate, Copper perchlorate, Copper EDTA complex, Nickel alkylamine complex, Iron piperidine complex, Cadmium pyridine complex, Iron bipyridine salt and Iron - acac complex;

wherein the 2D material is selected from the group consisting of graphene, porous graphene, gC_3N_4, single walled CNT, MoS_2, WS_2, SnS_2, phosphorene, graphene nanoparticles, TiC, and borophene;

wherein the electron facilitator is selected from the group consisting of neutral red, azo-dyes, Iron porphyrin complex, Schiff base complex, multi walled CNT, Cd (II) or Cu (II) imidazole complex, and Ruthenium complex;

wherein the surface directing agent is selected from the group consisting of Tween, sodium lauryl sulfate, p-172, Lauryl dimethyl amine oxide, Cetyltrimethylammonium bromide, Polyethoxylated alcohol, Polyoxyethylene sorbitan Octoxynol, N, N-dimethyldodecylamine-N-oxide, Hexadecyltrimethylammonium bromide, Polyoxyl 10 lauryl ether, sodium deoxycholate, sodium cholate, Polyoxyl castor oil, Nonylphenol ethoxylate, Cyclodextrins, Lecithin, and Methylbenzethonium chloride; and

wherein the counter ion precursor is a gaseous material or an organosulfur compound.

6. The process as claimed in 5, wherein the gaseous material is selected from the group consisting of H_2S containing gas, industrial flue gas, and bio gas.
7. The process as claimed in claim 5, wherein the organosulfur compound is selected from the group consisting of methanethiol, ethanethiol, propanethiol, butanethiol, thiophenol, ethanedithiol, 1,3ropanedithiol, 1,4 butanedithiol, thiophene, 2-mercaptoethanol, 3-mercaptopropanol, 4mercaptophenol, dithiothreitol, cysteine, homocysteine, methionine, thioserine, thiothreonine, thiotyrosine, glutathione, 2-thiouracil, 6-methyl-2-thiouracil, 4-thiouracil, 2,4dithiouracil, 2-thiocytosine, 5-methyl-2-thiocytosine, 5-fluoro-2-thiocytosine, 2-thiothymine, 4-thiothymine, 2,4-dithiothymine, 6-thioguanine, 8-thioadenine, 2- thioxanthine, 6-thioxanthine, 6-thiohypoxanthine, 6-thiopurine, dimethylsulfide, diethylsulfide, diphenylsulfide, biotin, cystine, lipoic acid, diphenyl disulfide, iron disulfide, 2- hydroxyethyldisulfide, thioacetic acid, trimethylsulfonium, diphenylmethylsulfonium chloride, dimethylsulfoxide, dimethylsulfone, thioketone, thioamide, thiocyanate, isothiocyanate, thiocarbamate, and dithiocarbamates.