**Pd-Ce NANOPARTICLES 2 nm USING CMC AND NaBH4**

Synthesis of PdCeCMC (i.e. 15 mg Na2PdCl4 dissolved in 15 ml H2O and 21.7 mg Ce(NO3)3.6H2O were separately dissolve in 15 ml H2O respectively) was repeated using CMC (150 mg Sodium carboxyl methyl cellulose Mw = 90k dissolve in 10 ml H2O) and sodium borohydride solutions 0.5 M (220 mg NaBH4 in 10.6 ml distilled water). 10.6 ml NaBH4 solution was added into the Pd-Fe-CMC mixture drop-wise at 500 rpm.

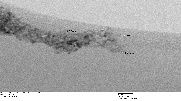


Fig. 1 TEM image of 2 nm

**Pd NANOPARTICLES 2-3 nm** **USING** **ETHYLENE GLYCOL** **WAS ACHIEVED (POLYOL METHOD)**

The polyol method is developed with 135.6 mg Pd(OAc)2 dissolved in 25 ml ethylene glycol (EG) at 90oC for 30 minutes with a stirring rate of 60 rpm under nitrogen environment. The experiment was also done at a reduced temperature of 40oC for 5 -10 minutes at 60 rpm.

A picture containing tree, outdoor, sky

Description automatically generated

Fig. 2 TEM image of 2-3 nm

**Pd-Fe NANOPARTICLES USING CMC AND NaBH4 (3:1 molar ratio)**

Synthesis of PdFeCMC 3:1 molar concentration (i.e. 15 mg Na2PdCl4 dissolved in 15 ml H2O and 5 mg FeSO4.7H2O were separately dissolve in 15 ml H2O respectively) was repeated using CMC (150 mg Sodium carboxyl methyl cellulose Mw = 90k dissolve in 10 ml H2O) and sodium borohydride solutions 0.05 M (9.4 mg NaBH4 in 5 ml distilled water). 3.6 ml NaBH4 solution into the Pd-Fe-CMC mixture drop-wise at 500 rpm.

**Smoke coming from it

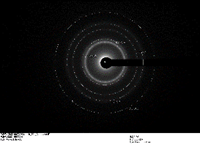
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Fig. 3 TEM image of 2-3 nm

**Pd-La NANOPARTICLES USING CMC AND NaBH4 (1:1 molar ratio)**

Synthesis of PdLaCMC 1:1 molar concentration (i.e. 15 mg Na2PdCl4 dissolved in 15 ml H2O (0.003M) and 21.7 mg La(NO3)2.6H2O were separately dissolve in 15 ml H2O (0.003 M) respectively) was repeated using CMC (150 mg Sodium carboxyl methyl cellulose Mw = 90k dissolve in 10 ml H2O) and sodium borohydride solutions 0.5 M (220 mg NaBH4 in 11.6 ml distilled water). 11.6 ml NaBH4 solution into the Pd-Fe-CMC mixture drop-wise at 500 rpm. pH = 9.

A picture containing bird, standing, group, flock

Description automatically generated

Fig. 4 TEM image of 2-6 nm

**Pd-La NANOPARTICLES USING CMC AND NaBH4 (3:1 molar ratio)**

Synthesis of PdLaCMC 1:1 molar concentration (i.e. 37 mg Pd(NO3)2.H2Odissolved in 15 ml H2O (0.009M) and 21.7 mg La(NO3)2.6H2O were separately dissolve in 15 ml H2O (0.003 M) respectively) was repeated using CMC (150 mg Sodium carboxyl methyl cellulose Mw = 90k dissolve in 10 ml H2O) and sodium borohydride solutions 0.5 M (220 mg NaBH4 in 11.6 ml distilled water). 11.6 ml NaBH4 solution into the Pd-Fe-CMC mixture drop-wise at 500 rpm. pH = 9.

A close up of a hill

Description automatically generated

Fig. 5 TEM image of 2 nm

**Pd-Ce NANOPARTICLES USING CMC AND NaBH4 (3:1 molar ratio)**

Synthesis of PdLaCMC 1:1 molar concentration (i.e. 37 mg Pd(NO3)2.H2Odissolved in 15 ml H2O (0.009M) and 21.7 mg Ce(NO3)3.6H2O were separately dissolve in 15 ml H2O (0.003 M) respectively) was repeated using CMC (150 mg Sodium carboxyl methyl cellulose Mw = 90k dissolve in 10 ml H2O) and sodium borohydride solutions 0.5 M (220 mg NaBH4 in 11.6 ml distilled water). 11.6 ml NaBH4 solution into the Pd-Fe-CMC mixture drop-wise at 500 rpm.

A picture containing black, sand, baseball

Description automatically generated

Fig. 6 TEM image of 2 nm

**Pd-Ce NANOPARTICLES USING CMC AND NaBH4 (1:1 molar ratio)**

Synthesis of PdLaCMC 1:1 molar concentration (i.e. 15 mg Na2PdCl4 dissolved in 15 ml H2O (0.003M) and 21.7 mg Ce(NO3)3.6H2O were separately dissolve in 15 ml H2O (0.003 M) respectively) was repeated using CMC (150 mg Sodium carboxyl methyl cellulose Mw = 90k dissolve in 10 ml H2O) and sodium borohydride solutions 0.5 M (220 mg NaBH4 in 11.6 ml distilled water). 11.6 ml NaBH4 solution into the Pd-Fe-CMC mixture drop-wise at 500 rpm. pH = 9.

A picture containing rain

Description automatically generated

Fig. 7 TEM image of 2-3 nm