# *Supplementary Material*

## 1 Supplementary Figures and Tables

**Supplementary Table 1.** Details of the Boolean advanced search query: theme, strings, search query, and results, based on the Scopus database (source: the authors).

| Theme | Boolean advanced search query | Results |
|---|---|---|
| Electrochemical degradation of contaminants with BDD electrodes | *TITLE* (bdd *OR* "boron doped diamond" *OR* "boron-doped diamond") *AND* TITLE (*degradation *OR* treatment *OR* remov* *OR* mineralization *OR* remediation *OR* "electrochemical oxidation" *OR* destruction *OR* *oxidation *OR* incineration *OR* disinfection *OR* wastewater* *OR* combustion *OR* elimination *OR* decomposition)) *AND* (*LIMIT-TO* (*DOCTYPE*, "ar")) *AND* (*LIMIT-TO* (*LANGUAGE*, "English") | Scopus: 875 (04/2022) |

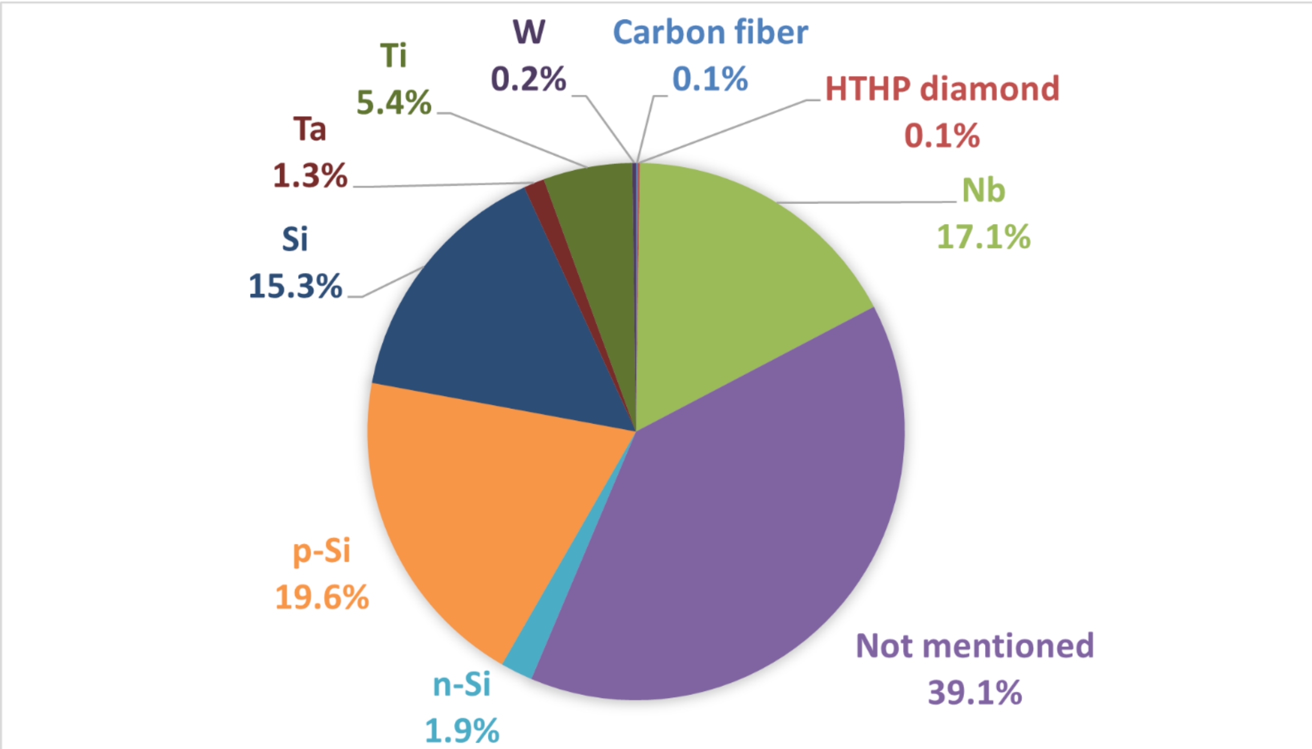
**Supplementary Table 2.** Previously identified commonly used strings for describing the degradation of contaminants with BDD electrodes (source: the authors).

| **Strings** |
|---|
| *degradation (*e.g.* electrodegradation, degradation) |
| treatment |
| remov* (*e.g.* removal, removing) |
| mineralization |
| remediation |
| "electrochemical oxidation" |
| destruction |
| *oxidation (*e.g.* electrooxidation, electro-oxidation, oxidation) |
| incineration |
| disinfection |
| wastewater* (*e.g.* wastewater, wastewaters) |
| combustion |
| elimination |
| decomposition |

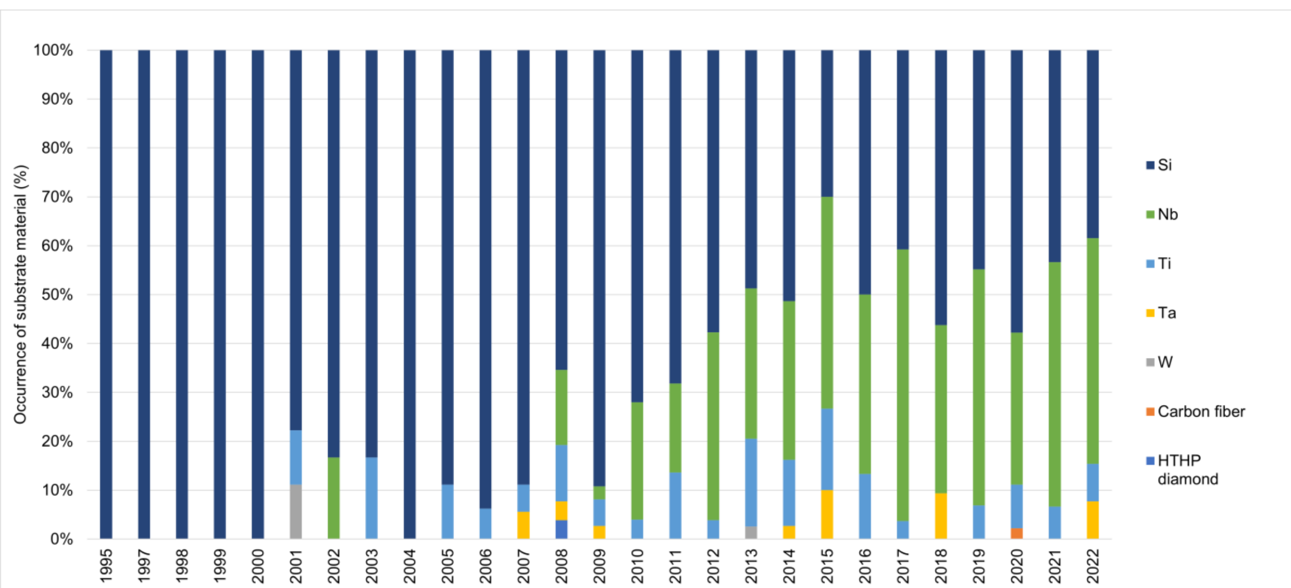
**Supplementary Table 3.** List of commercial BDD suppliers (source: the authors).

| Commercial BDD supplier | Country or Province | Website |
|---|---|---|
| 3betterdiamond[e] | China | https://www.3betterdiamond.com/ |
| Adamant Innotech S.A.[a] | Switzerland | https://adamant-innotech.ch/ |
| Advanced Diamond Technology | USA | http://www.thindiamond.com/ |
| Antec Scientific | The Netherlands | https://antecscientific.com/ |
| BioLogic[e] | France | https://www.biologic.net/ |
| Boromond[e] | China | https://www.boromond.com/ |
| Condias[b] | Germany | https://www.condias.de/ |
| Creating Nano Technologies Inc | Taiwan | http://www.creating-nanotech.com/ |
| CSEM[d] | Switzerland | https://www.csem.ch/ |
| Diaccon | Germany | https://www.diaccon.de/ |
| Diamond Electric[e] | USA | https://diamond-us.com/ |
| Ecotricity[e] | UK | https://www.ecotricity.co.uk/ |
| EUT GmbH | Germany | https://www.eut-eilenburg.de/ |
| Electrolytic Ozone[e] | USA | http://www.eoi-oxygen.com/ |
| Element Six (De Beers Group) | USA | https://www.e6.com/ |
| Eletrocell | Denmark | https://www.electrocell.com/ |
| Eletrolytica | USA | http://www.electrolytica.com/ |
| ESA Biosciences[c,e] | USA | https://www.thermofisher.com/ |
| Evoqua (Magneto Special Anodes B.V.) | The Netherlands | https://www.evoqua.com/ |
| Fraunhofer, CCD - Center for coatings and diamond technologies | USA | https://www.fraunhofer.org/ |
| GL Sciences[e] | Japan | https://www.glsciences.com/ |
| Kraftangalen[e] | Germany | https://www.kraftanlagen.com/ |
| Metakem | Germany | https://metakem.de/ |
| Metrohm DropSens[e] | Spain | https://www.dropsens.com/ |
| Neocoat[a] | Switzerland | https://www.neocoat.ch/ |
| Schunk Carbon Technology[e] | Germany | https://www.schunk-carbontechnology.com/ |
| Shazay[e] | Germany | https://shazay.com/ |
| sp3 Diamond Technologies | USA | https://www.sp3diamondtech.com/ |
| Sumitomo Electric Industries | Japan | https://sumitomoelectric.com/ |
| Umex | Germany | https://www.umex.de/ |
| * Waterdiam France | France | - |
| WCS Environmental Engineering Ltd[e] | UK | https://wpldiamond.com/ |
| Weiss Technik[e] | Germany | https://www.weiss-technik.com/ |
| Wesco | USA | https://www.wesco.com/ |
| * Windsor Scientific | UK | - |
| Zhengzhou Abrasives & Grinding Research Institute Co. | China | http://www.zzsm.com/ |

[a] Spin-off company of CSEM
[b] Spin-off company of Fraunhofer Institute for Thin Films and Surface Technology
[c] Acquisition of Thermo Fischer Scientific
[d] Start-ups or joint ventures based on CSEM technologies: NeoCoat and Adamant Innotech S.A.
[e] Suppliers not identified in the articles from the bibliometric analysis research
*Liquidation




**Supplementary Figure 1.** Choice of substrate material based on the bibliometric analysis search (source: the authors).




**Supplementary Figure 2.** Choice of substrate material along the years, based on the bibliometric analysis search (source: the authors).

**Supplementary Table 4.** Reported studies on phenol degradation using BDD electrodes as anodes in its electrooxidation.

| BDD | % removal | | | Energy Consumption | | | | ACE (%) | Initial concentration | | j ($mA/cm^2$) | t (h) | A ($cm^2$) | V (mL) | Initial pH | Supporting Electrolyte | Conductivity (mS/cm) | Flow Rate (mL/s) | T (°C) | Electrochemical Characterization | Ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | COD | Phenol | TOC | kWh/kg COD | kWh/kg phenol | $kWh/m^3$ | kWh/kg TOC | | Phenol (mg/L) | COD (mg/L) | | | | | | | | | | | |
| In house HFCVD | 100% | - | - | 112 | - | - | - | - | 240 | 548 | 20 | 3.2 | 24 | 200 | 3 | 0.05 M $Na_2SO_4$ and 2 M $H_2SO_4$ | - | - | 10 | RE: SCE<br>ES: 0.05 M $Na_2SO_4$<br>EPW: -<br>OEP: ~1.8V | (Zhao et al., 2009) |
| In house MPCVD | - | - | 85% | - | - | - | - | - | 941.1 | - | 70-900 | ~68.5 | 2 | 1000 | - | 0.1 M $H_2SO_4$ | - | 7 | - | RE: Pd/$H_2$<br>ES: 0.1 M $H_2SO_4$<br>EPW: -<br>OEP: 1.5V | (Hagans et al., 2001) |
| In house HFCVD | 95% | 100% | - | - | - | 8.15 | - | 21.8% | 94.11 | 224 | 15 | ~15 | 1.5 | 100 | 2 | 0.5 M $Na_2SO_4$ | - | - | RT | RE: SCE<br>ES: 0.5 M $H_2SO_4$<br>EPW: 1.5 to 2.5 V<br>OEP: 2.5V | (Sun et al., 2012) |
| In house HFCVD | 94% | - | 80% | - | - | 27.5 (for 80% removal) | - | 15.6% | 94.11 | - | 30 | 5 | 16 | 500 | - | 0.5 M $Na_2SO_4$ | - | 16.67 | - | RE: Ag/AgCl<br>ES: 0.5 M $H_2SO_4$<br>EPW: 1.9 V<br>OEP: 1.6 V | (Lee et al., 2017) |
| In house HFCVD | - | - | 55% | - | - | - | 29 | * 18% (MCE) | - | - | 50 | 3 | 4 | 250 | - | 0.1 M $Na_2SO_4$ | - | - | RT | RE: Ag/AgCl<br>ES: 0.5 M $H_2SO_4$<br>EPW: 3.1 V<br>OEP: 2.2 V | (Li et al., 2021) |
| In house MPCVD | 70% | 78% | - | - | - | - | - | 23.8% | 94.11 | - | 20 | 5 | 4 | 250 | 12 | 0.2 M $Na_2SO_4$ | - | - | RT | RE: SCE<br>ES: 0.2 M $Na_2SO_4$<br>EPW: 3.1 V<br>OEP: 2.1 V | (Zhu et al., 2007) |
| In house HFCVD | - | 90% | - | - | - | - | - | 22.3% | 470.55 | - | 60 | 2,1 | 50 | 500 | - | 1 M $HClO_4$ | - | - | 25 | RE: SHE<br>ES: 1 M $HClO_4$<br>EPW: -<br>OEP: 2.3 V | (Iniesta, 2001) |
| In house HFCVD | 51% | - | - | - | - | - | - | - | 3.764.4 | 9153 | 100 | 4 | 3 | 40 | - | $H_2SO_4$ | - | - | - | RE: SCE<br>ES: -<br>EPW: 3.29 V<br>OEP: 2.42 V | (Shi et al., 2020) |
| In house HFCVD | 96.6% | - | - | - | - | - | - | 78.5% | - | 1175 | 10 | - | 6.25 | 30 | - | 2000 mg/L $Na_2SO_4$ | - | - | 30 | RE: NHE<br>ES: 0.5 M $H_2SO_4$<br>EPW: 3.0 V<br>OEP: 2.4 V | (Chen et al., 2003) |
| In house HFCVD | 95.7% | - | - | - | - | - | - | - | - | 1175 | 10 | - | 5 | - | 4.70–6.73 | 1500 mg/L $Na_2SO_4$ | - | - | 30 | RE: NHE<br>ES: 0.5 M $H_2SO_4$<br>EPW: -<br>OEP: 2.7 V | (Chen et al., 2005) |
| In house HFCVD | 97% | - | - | - | - | - | - | - | 50 | - | 50 | - | 0.15 | - | 2–3 | 0.1 M $H_2SO_4$ | - | - | 20 | RE: Ag/AgCl<br>ES: 0.1 M $H_2SO_4$<br>EPW: 2.4 to 3.5 V<br>OEP: 2.0 to 2.2 V | (Kornienko et al., 2011) |
| Adamant Technologies | - | 93% | - | - | - | - | - | - | 941.1 | - | - | 4 | 21 | 80 | - | 0.5 M $H_2SO_4$ | - | - | - | - | (Pujol et al., 2020) |
| Adamant Technologies | - | - | 79.8% | - | - | - | - | - | 941.1 | - | 32.5 | 3 | 6.16 | 30 | - | 0.1 M $KNO_3$ | - | - | - | - | (Yoon et al., 2012) |
| Adamant Technologies | - | 100% | 100% | - | - | - | - | - | 100 | - | 2.5 | 9 | 40 | 500 | 2 | 0.04 M $Na_2SO_4$ / 0.05 H2SO4 | 18.1 | 12.5 | 23 ± 2 | - | (Espinoza-Montero et al., 2013) |
| Adamant Technologies | 51% | - | 46% | - | - | - | - | 76% | 300 | - | 10 | 10 | 70 | 30000 | - | 0.035 M $Na_2SO_4$ | - | 138.89 | - | - | (Lopes et al., 2011) |
| Adamant Technologies | 34-42% | - | - | - | - | - | - | - | - | 1000 | 30 | ~4 | 2.5 | 150 | - | 0.035 M $Na_2SO_4$ / NaOH | - | - | 20 | RE: SCE<br>ES: $Na_2SO_4$<br>EPW: -<br>OEP: 0.5V | (Cañizares et al., 2008) |
| Condias | 77% | - | - | 31 | - | - | - | - | - | 633 | 8.5 | 1.33 | 2904 | 4501 | - | - | 3 | 0.85-9.38 | - | - | (Zhu et al., 2010b) |
| Condias | 98.9% | 100% | 100% | 57 | - | - | - | 19.1% | 100 | - | 30 | 3.5 | 78.5 | 2000 | 4.8 | 1100 mg/L $Na_2SO_4$ | - | - | 23 ± 3 | - | (Jarrah and Mu'azu, 2016) |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Condias | - | 77% | 40% | - | - | - | - | - | 50 | - | 9.04 | 1 | 77.44 | 500 | - | 10 mM $NaNO_2$ | - | 6.68 | - | RE: SCE<br>ES: $NaNO_3$<br>EPW: -<br>OEP: 1.77 V | (Zhang et al., 2019) |
| Condias | - | 97% | 58% | - | - | - | - | - | 94.11 | - | 20 | 8 | 4 | 250 | - | 0.2 M $Na_2SO_4$ | - | - | 25 | - | (Jiang et al., 2020) |
| Condias | - | - | 58% | - | - | - | - | - | 94.11 | - | 20 | 4 | 4 | 250 | 11 | 0.2 M $Na_2SO_4$ | - | - | 25 | - | (Jiang et al., 2017) |
| Condias | - | 32% | - | - | - | - | - | - | 47.06 | - | 10 | 1 | 2 | 200 | 6.50 | 20 mM $Na_2SO_4$ | - | - | - | RE: Ag/AgCl<br>ES: 20 mM $Na_2SO_4$<br>EPW: 2.3 V<br>OEP: 1.93 V | (Chen et al., 2022) |
| Condias | 91% | 100% | 99% | - | 99 | - | - | 82% | 1000 | - | 30 | 4.5 | 78.5 | 2000 | 2 | 1000 mg/L $Na_2SO_4$ | - | - | - | - | (Dalhat Mu and H. Al-Mala, 2012) |
| Condias | - | - | - | - | 329.52 | - | - | 19.89% | 65.99 | 135.99 | 30 | 0.5 | 78.5 | 2000 | 4.8 | 1100 mg/L $Na_2SO_4$ | - | - | RT | - | (Mu'azu et al., 2013) |
| Condias | 86% | - | - | - | - | - | - | - | - | - | 20 | 5 | 4 | 250 | - | 0.2 M $Na_2SO_4$ | - | - | 25 | RE: SCE<br>ES: 0.2 M $Na_2SO_4$<br>EPW: -<br>OEP: 2.1 V | (Zhu et al., 2010a) |
| Condias | 80% | - | - | 110 | - | - | - | - | - | 500 | 19.5 | 1.15 | 24 | - | - | 0.05 M $Na_2SO_4$ | - | - | - | - | (Wei et al., 2011) |
| Condias | 100% | - | - | - | - | - | - | 19% | 100 | - | 30 | 2.5 | 78.5 | 2000 | - | 1100 mg/L $Na_2SO_4$ | - | - | - | - | (Muazu et al., 2014) |
| Condias | 98% | - | - | - | - | - | - | 87% | 200 | - | 30 | 8 | 8 | 150 | - | - | - | 8.35 | 25 | - | (Pacheco et al., 2007) |
| CSEM | 100% | - | - | - | - | - | - | 56% | - | 2400 | 30 | - | 78 | - | 2 | 5000 mg/L $Na_2SO_4$ / $H_2SO_4$ | - | 41.67 | 25 | - | (Canizares et al., 2005) |
| CSEM | 99% | - | - | - | - | 80 | - | - | 1882.2 | - | 47 | 5 | 63 | 990 | - | 0.1 M $H_2SO_4$ | - | 55.55 | - | - | (Weiss et al., 2007) |
| EUT | 96% | - | 96% | 82 | - | - | - | 23% | 280 | 666 | 50 | 5.8 | 28 | - | - | $Na_2SO_4$ | - | - | 27-30 | RE: Ag/AgCl<br>ES: 0.3 M $Na_2SO_4$<br>EPW: -<br>OEP: 1.0 V | (de Souza and Ruotolo, 2013) |
| EUT | 91% | - | 94% | 26.6 | - | - | - | - | - | 378 | 30 | 8 | 16 | 2560 | - | 0.1 M $H_2SO_4$ | - | 40 | 30 | - | (Farinos and Ruotolo, 2017) |
| Magneto Special Anodes B.V. | - | 99.54% | - | - | 470 | - | - | - | 200 | 590 | 5 | 1.25 | 176 | 500 | 1.97 | $Na_2SO_4$ | 15.63 | - | 20 | - | (Yavuz et al., 2008) |
| Umex | 78% | - | 78% | 475 | - | - | - | - | 210 | 500 | 150 | 8 | 28 | 2500 | 0.76 – 0.87 | 0.1 M $H_2SO_4$ | - | - | 26-28 | RE: Ag/AgCl<br>ES: 0.1 M $H_2SO_4$<br>EPW: -<br>OEP: 2.0 V | (Britto-Costa and Ruotolo, 2012) |
| - | ~100% | - | - | - | - | - | - | - | 1985 | - | 215 | 3 | 7 | 100 | 13 | 0.1 M $Na_2SO_4$ | - | - | 30 | - | (Bouaziz et al., 2017) |
| - | 99% | - | - | - | - | - | - | - | 202-222 | - | 30 | 6.2 | 10.14 | 250 | 7 | 0.1 M $Na_2CO_3$ | - | - | 25 | - | (Morão et al., 2004) |
| - | 98% | - | - | - | - | - | - | 12.3% | 240 | 548 | 20 | 3 | 24 | 200 | 3 | 0.05 M $Na_2SO_4$ / 2 M $H_2SO_4$ | - | - | - | RE: SCE<br>ES: 0.05 M $Na_2SO_4$<br>EPW: -<br>OEP: ~1.5 V | (Zhao et al., 2008) |
| - | 84% | - | - | - | - | - | - | - | 280 | 666 | 100 | 8 | 70 | 1500 | 2.0–3.5 | 0.1 M $Na_2SO_4$ / $H_2SO_4$ / NaOH | - | - | 27–30 | - | (Souza and Ruotolo, 2013) |
| - | - | 100% | 20% | - | - | - | - | *45% (MCE) | 50 | - | 40 | 0.5 | 100 | 20000 | 7 | - | 2480 | 1111.11 | - | - | (Tawabini et al., 2020) |
| - | - | 80.1% | 62.5% | - | - | - | - | - | 50 | - | 6.46 | 2 | 77.44 | 500 | - | 1 mM NaBr | - | 6.68 | - | RE: SCE<br>ES: 1 mM NaBr<br>EPW: -<br>OEP: 1.9 V | (Zhang et al., 2018) |

*EC = energy consumption; RT = room temperature; EPW = electrochemical potential window; ES = electrolyte solution; RE =: reference electrode*

**Supplementary Table 5.** Reported studies on landfill leachate degradation using BDD electrodes as anodes in its electrooxidation.

| BDD | $COD_0$ (mg $O_2$/L) | COD removal (%) | ACE (%) | EC (kWh/kg COD) | j (mA/cm²) | t (h) | Anode area (cm²) | Volume (mL) | Initial pH | Supporting Electrolyte | Conductivity (mS/cm) | Flow Rate (mL/s) | T (°C) | Electrochemical characterization | Ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In house HFCVD | 3778.56 ± 42.91 | 87.5% | 41.7% | *223.2 kWh/m³ | 50 | 6 | 24 | 200 | 5.16 ± 0.12 | 1 M NaOH | 40.16 ± 0.25 | 1.67 | - | ES: 1 M $H_2SO_4$<br>RE: Ag/AgCl<br>EPW: 3.0 V<br>OEP: 2.3 V | (Zhou et al., 2016) |
| In house MPCVD | 3608 ± 123 | 91% | 28% | 285 | 100 | 4 | 10.5 | 400 | 7.8-9.4 | - | - | - | 25 ± 1 | ES: 1 M KCl<br>RE: Ag/AgCl<br>EPW: 3.9 V<br>OEP: 1.4 V | (Wilk et al., 2021) |
| In house MPCVD | 4002.11 ± 13.12 | 69% | 43.9% | *215.4 kWh/m³ | 50 | 5.5 | 30 | 200 | 6.01 ± 0.01 | - | 12.4 ± 0.1 | 1.53 | - | ES: 0.5 M $H_2SO_4$<br>RE: Ag/AgCl<br>EPW: 2.2 V<br>OEP: 1.6 V | (Zhao, 2021) |
| Adamant Technologies | 1130 | 100% | - | - | 15-90 | 6-8 | 70 | 1000 | 7.51 | - | 14.36 | 183.33 | 20 | | (Cabeza et al., 2007) |
| CSEM | 780 | 100% | 24.5% | *150 kWh/m³ | 40 | 4 | 50 | 350 | 8.20 | - | 9.77 | 116.67 | 25 | | (Panizza and Martinez-Huitle, 2013) |
| Adamant Technologies | 3385 | 51% | - | 102-134 (for 30% removal) | 90-120 | 8 | 70 | 10000 | 8.4 | NaCl | 22.6 | 166.67 | - | | (Anglada et al., 2011) |
| Adamant Technologies | 860 | 100% | - | - | 30-120 | 4-8 | 10500 | 230000 | - | - | 9.4 | 5000 | - | | (Anglada et al., 2009) |
| Condias | 5800 | 88% | - | - | 30 | 6 | 10 | 200 | 8.4 ± 0.4 | 0.03 M $Na_2SO_4$ | 22.1 | - | 25 | | (Fernandes et al., 2012) |
| Fraunhofer | 1168 | 93% | - | 5.7 | 37.5 | 8 | 8 | 2000 | 5 | $Na_2SO_4$ | | 7 | - | | (Bagastyo et al., 2020) |
| NeoCoat | 6200 ± 400 | 40% | - | *64 kWh/m³ | 30 | 6 | 10 | 200 | 9.0 ± 0.1 | - | 22.0 ± 1.2 | - | 22–25 | | (Fernandes et al., 2014) |
| De Nora | 3308–3540 | 95.17% | 14.4% | 160 | 83 | 8 | 6 | - | 2 | NaOH or $H_2SO_4$ | 17.3–18.5 | 2.78 | - | | (Luu, 2020) |
| - | 2040 | 49% | - | 86.4 | 100 | 7 | 8 | 1000 | 8.5 | - | 10.74 | 2 | - | | (Agustina et al., 2019) |
| - | 2011 | 74% | - | - | 50 | 4 | 8 | 1000 | 3 | 0.05 M NaCl | | 5 | - | | (Nurhayati et al., 2020) |
| - | 816 | 87% | 193% | 45.8 | 67 | 8 | 6 | 2000 | 6 | $H_2SO_4$ | 2.91 | 5 | - | | (Bagastyo et al., 2021) |
| - | 888 | 92% | 21.68% | 136.0 | 36 | 4 | 84 | 950 | 7.65 | - | 19.31 | - | - | | (Ukundimana et al., 2018) |

*EC = energy consumption; EPW = electrochemical potential window; ES = electrolyte solution; RE = reference electrode*

## References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