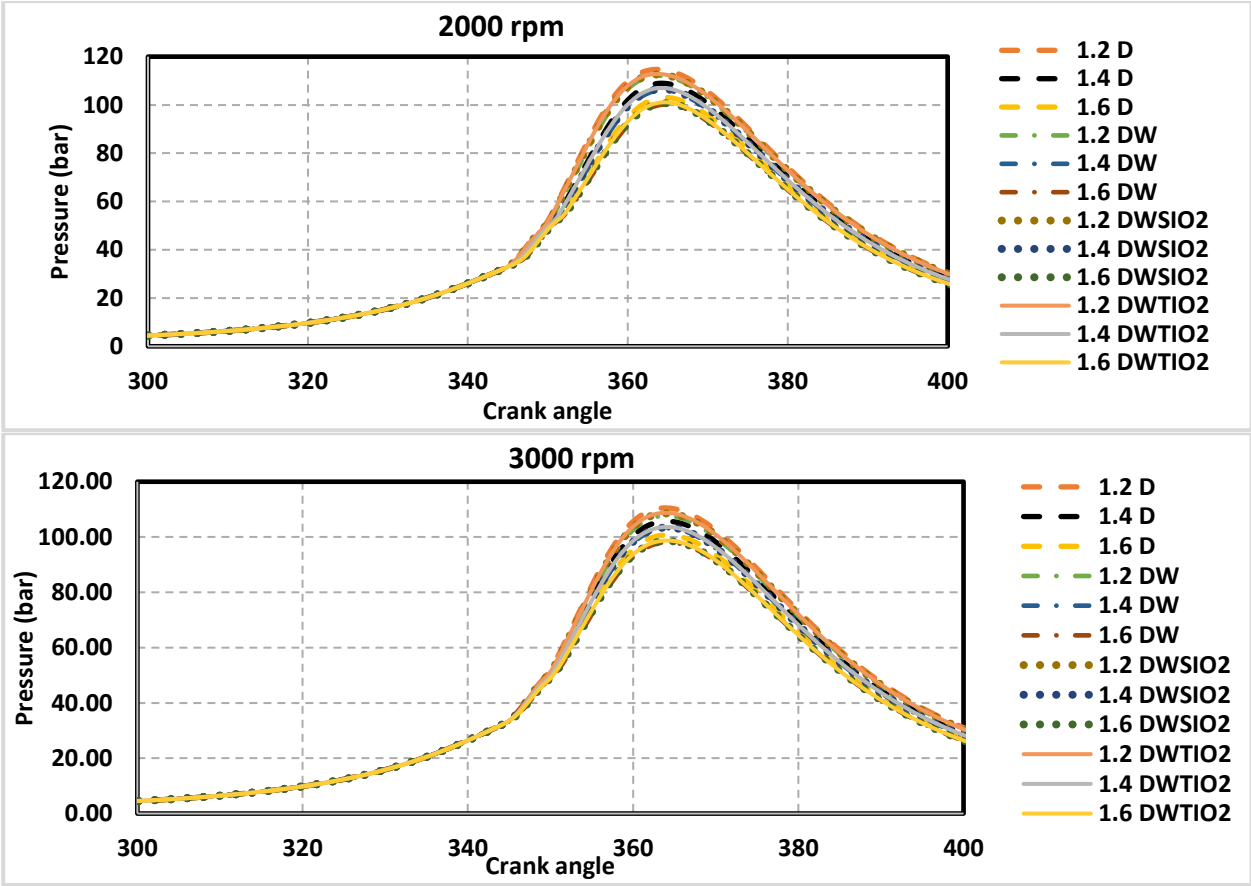




Supplementary Materials

Table A.1 Specifications of nanoparticles(Vigneswaran et al., 2021, Khatri and Goyal, 2020)

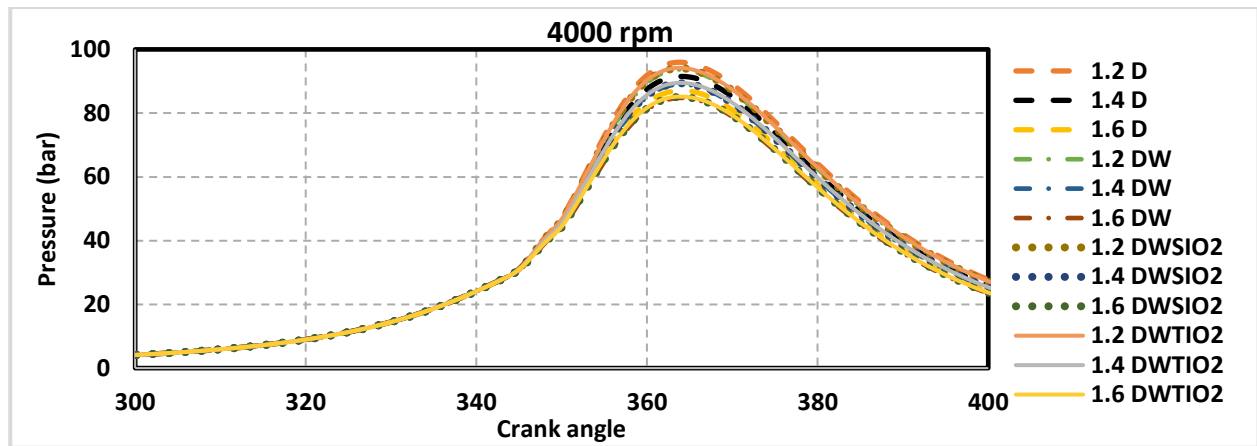
|                  | 50µm                   | 50µm                  |
|------------------|------------------------|-----------------------|
| Chemical name    | Titanium oxide         | Silicon dioxide       |
| Formula          | TiO <sub>2</sub>       | SiO <sub>2</sub>      |
| Density          | 4.23 g/cm <sup>3</sup> | 2.2 g/cm <sup>3</sup> |
| Appearance       | white solid            | white Powder          |
| Point of boiling | 2,972 °C               | 2503 K                |
| Point of melting | 1843 °C                | 1986 K                |
| Molecular Weight | 79.87 g/mol            | 231.533 g/mol         |



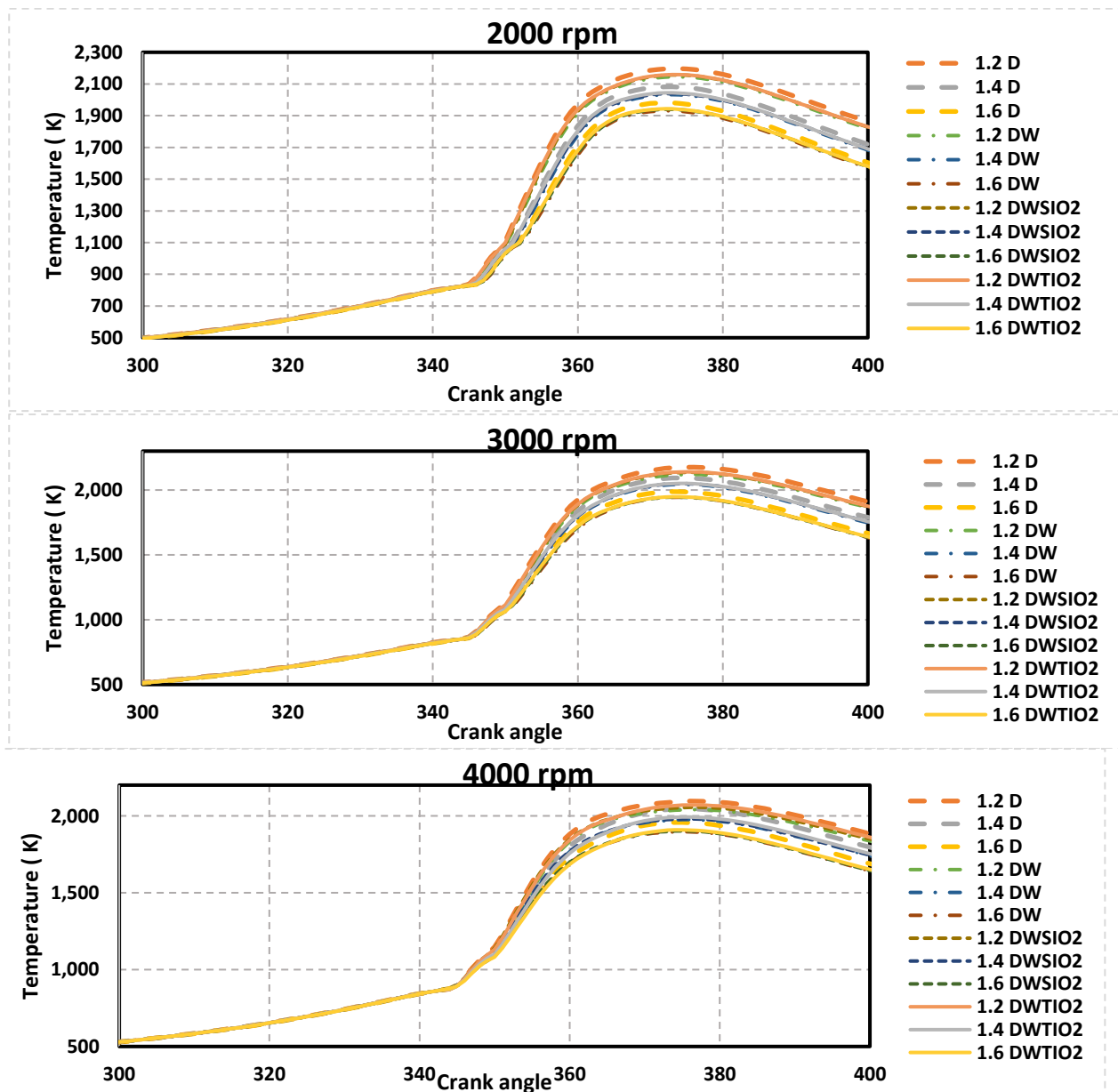
For grants, please provide the grant number and the year it was received. Write it as follows: "This work was supported by the 'Name of organization' funded by 'Name of Grant and number' "

<https://doi.org/xx/ijtech.xx>

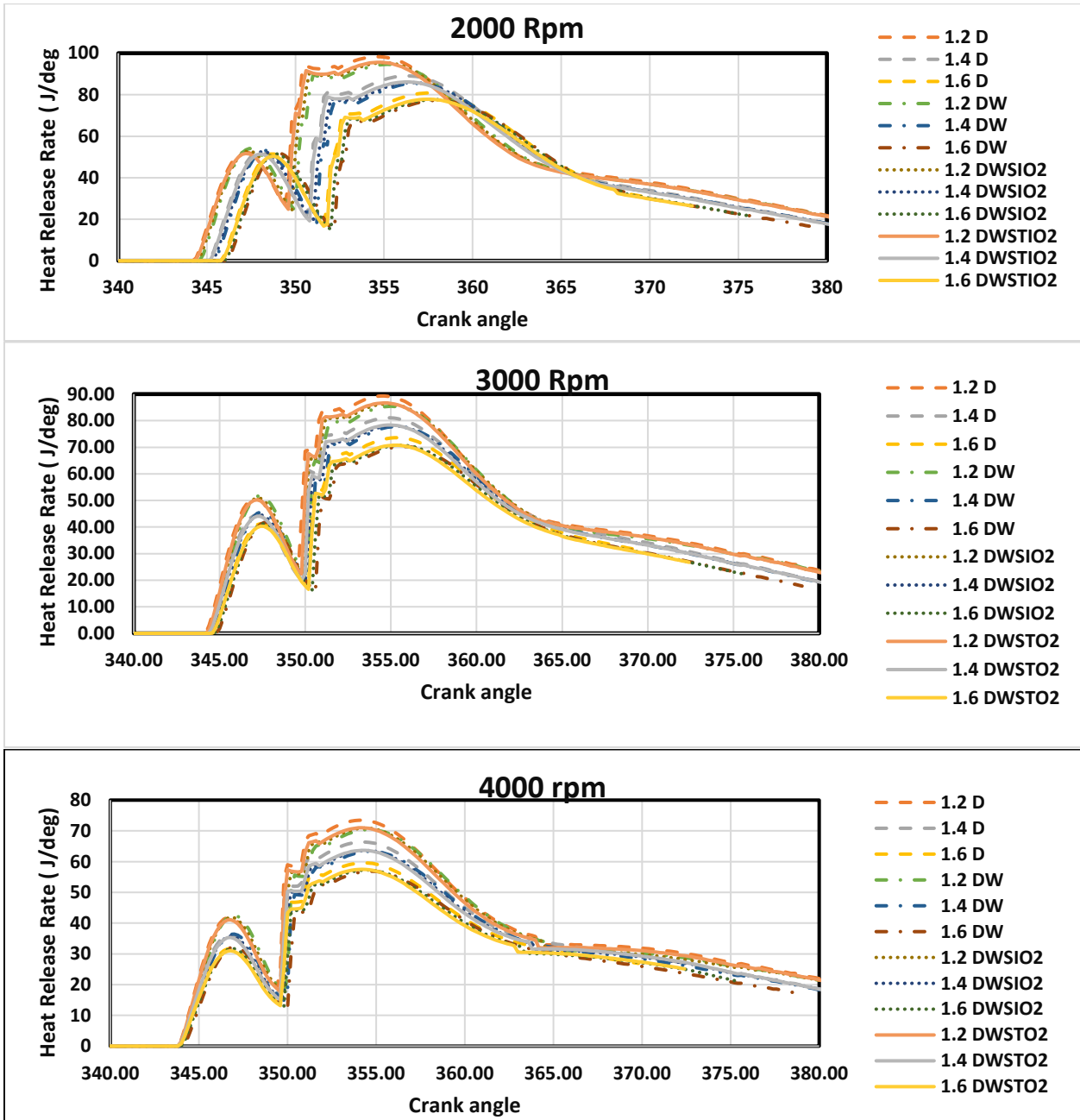
Received date; Revised date; Accepted date



**Figure A.1** The relationship between the pressures and the crank angle under different lambda values and different additives in diesel fuel at various engine speeds (2000 rpm, 3000 rpm, and 4000 rpm).



**Figure A.2** The relationship between the temperature and the crank angle under different lambda values and different additives in diesel fuel at various engine speeds (2000 rpm, 3000 rpm, and 4000 rpm).



**Figure A.3** The relationship between heat release rate and the crank angle under different lambda values and different additives in diesel fuel at various engine speeds (2000 rpm, 3000 rpm, and 4000 rpm)

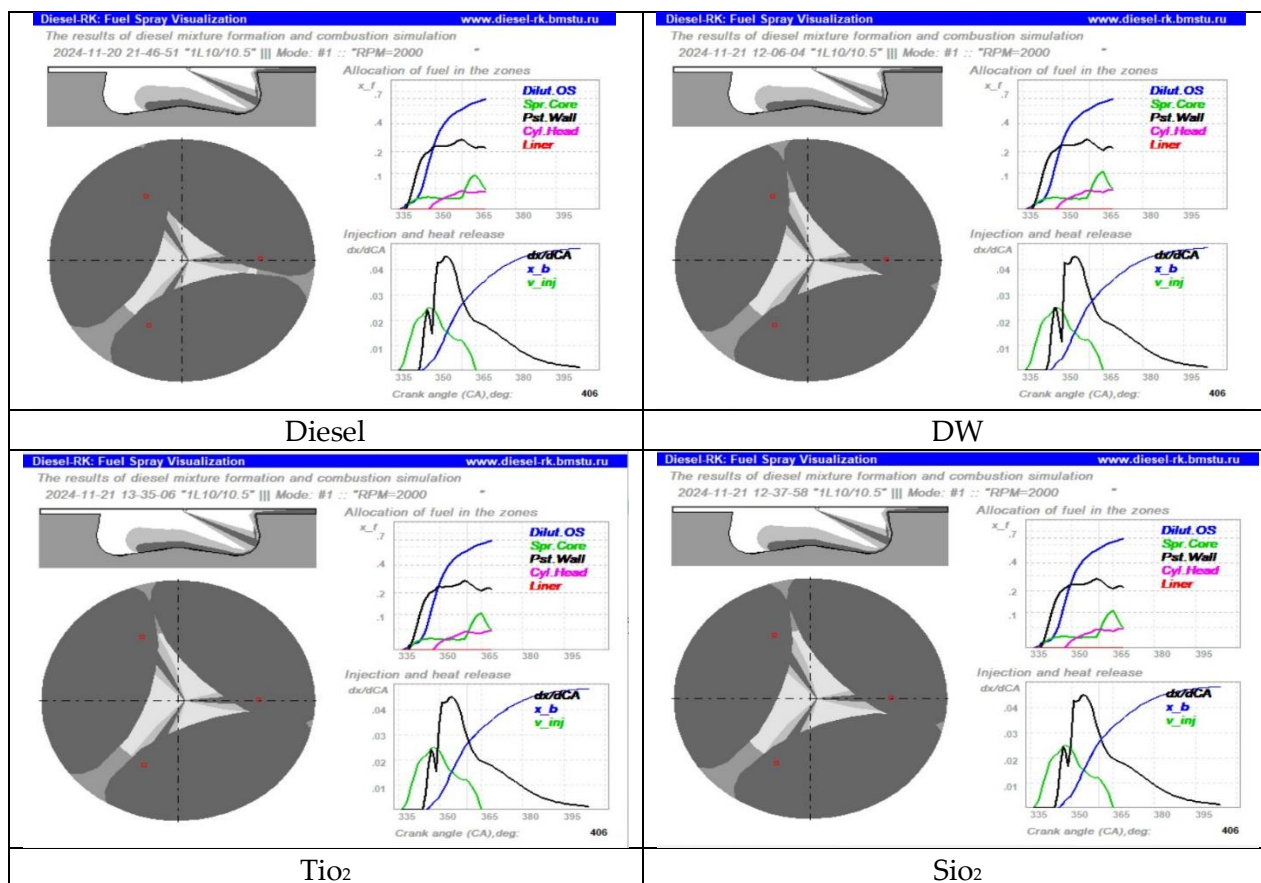


Figure A.4 Fuel spray visualization at 2000 rpm and lambda 1.2

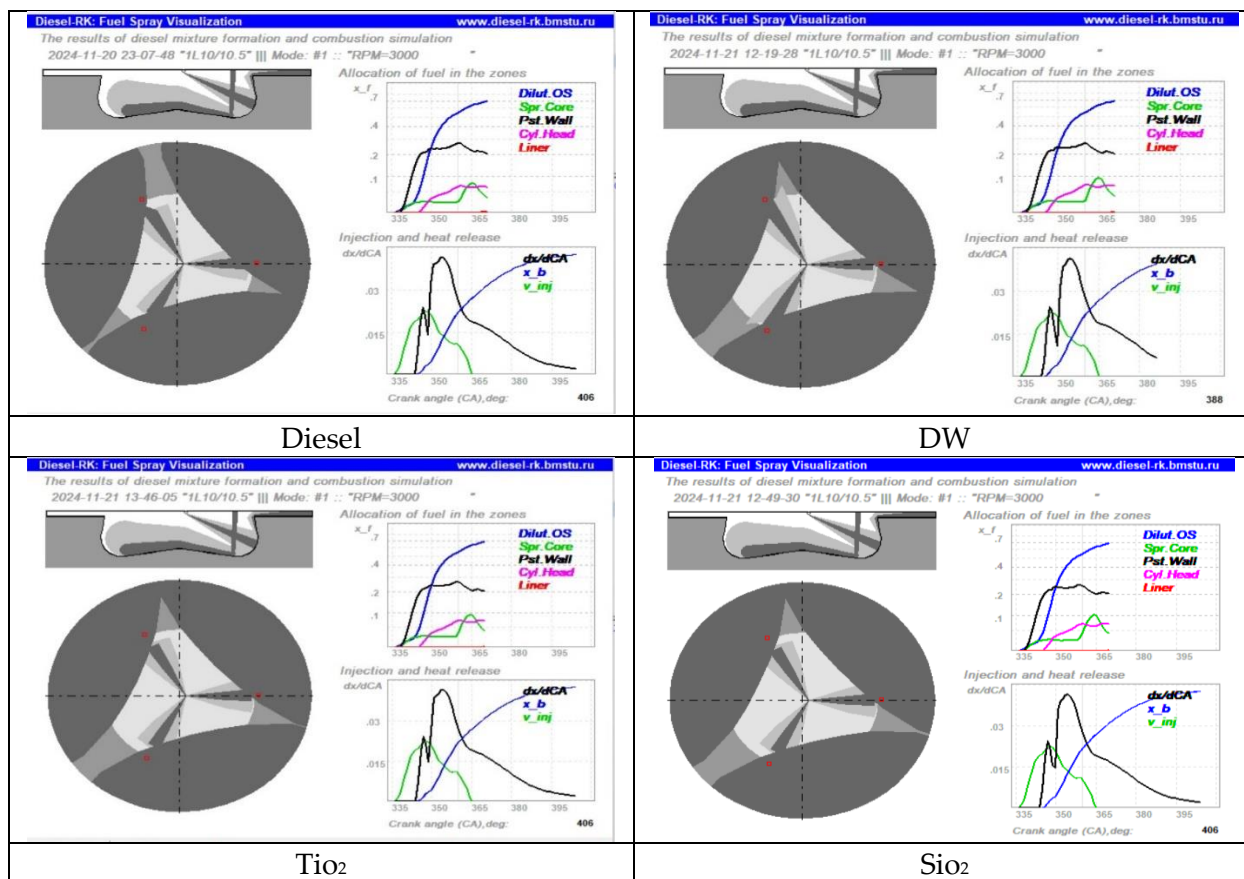


Figure A.5 Fuel spray visualization at 3000 rpm and lambda 1.2

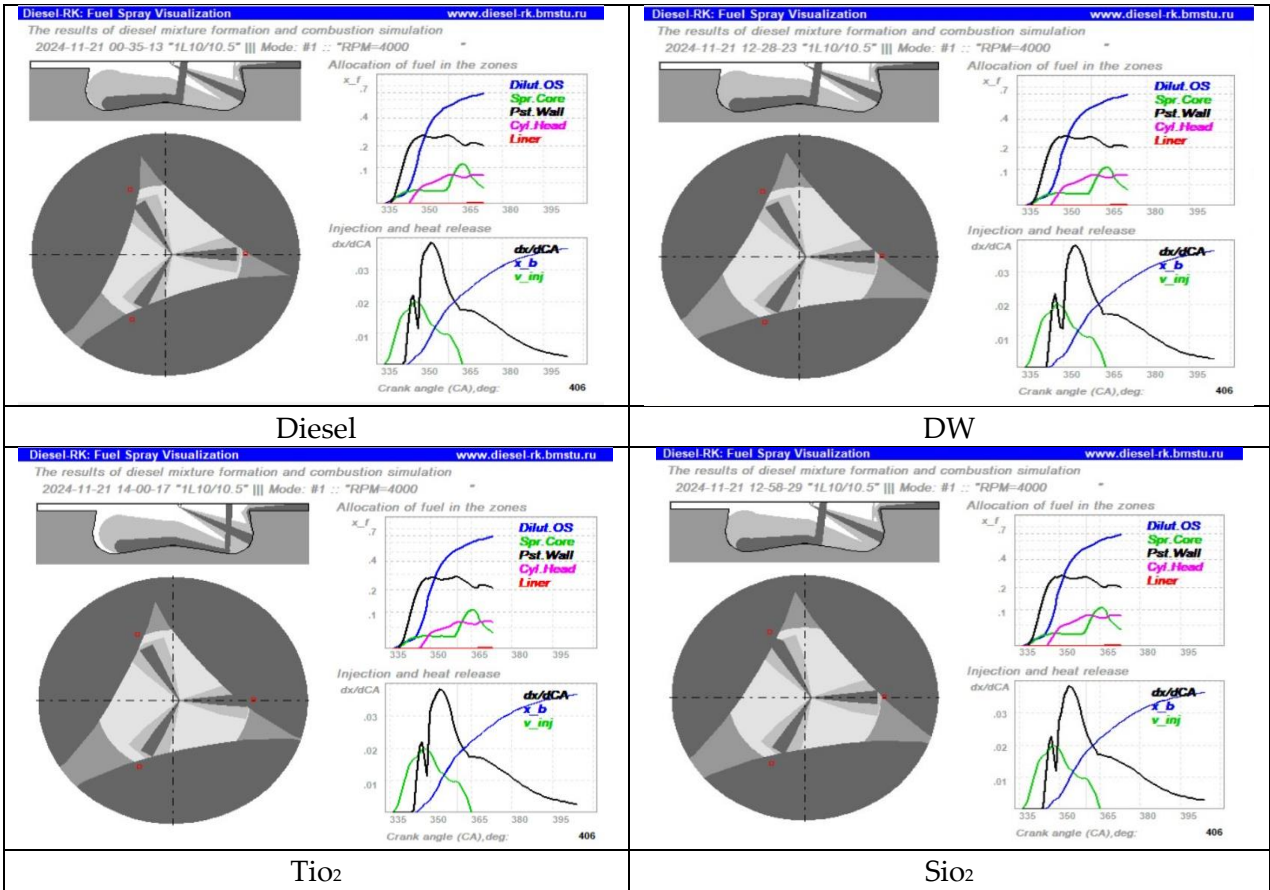


Figure A.6 Fuel spray visualization at 4000 rpm and lambda 1.2