

# **Microwave Plasma Assisted Chemical Vapor Deposition Process Variable Optimization of Nitrogen Doped Single Crystal Diamond**

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<b>roduction</b> amond is a strong ndidate for quantum	presents a materials engineering challenge of precision control of this defect system. The first	<ul> <li>Experimental Setup</li> <li>Microwave Plasma Assisted CVD Reactor</li> <li>Microwave Source frequency: 2.45GHz</li> </ul>	Sample ID	H <sub>2</sub> Flow Rate (SCCM)	CH <sub>4</sub> Flow Rate (SCCM)	N <sub>2</sub> in H <sub>2</sub> Flow Rate (SCCM)	Gas Phase N <sub>2</sub> conc. ppm	Temperature (°C)	Pressure (mbar)
vices due to its ultra-	step to combating this	<ul> <li>Microwave power adjusted to maintain</li> </ul>	SR21e	400	16	17.5	48	950	290
de band gap and the	challenge requires control	temperature	SR21b	400	16	17.5	48	1000	290
tope. <sup>12</sup> C. having zero	of the substitutional	Microwave power supply	SR21c	400	16	17.5	48	1050	290
clear snin [1]	nitrogen that can later be	P <sub>inc</sub> , P <sub>ref</sub> , P <sub>abs</sub>	21 08/19	368	16	16.5	50	950	250





### Conclusions

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- The ideal deposition temperature was concluded to be 950°C due to the smooth step flow growth and moderate growth rate.
- FTIR absorption peaks at 1330 cm<sup>-1</sup> and 2930 cm<sup>-1</sup> appear correlated with an
- 1330 cm<sup>-1</sup> and 2930 cm<sup>-1</sup> correlate to quality of crystal
- Sample color post deposition could be

1330 cm <sup>-1</sup> FTIR	≈0	Local max	Decrease	≈0
2930 cm <sup>-1</sup> FTIR	≈0	Local max	Decrease	≈0
Growth Rate	19.12 ± 0.6 um	25.04 ± 0.91 um	23.0 ± 1.23 um	30.44 ± 1.79 um
			Pill	

- Peaks observed at 1330 cm<sup>-1</sup> and 2930 cm<sup>-1</sup> decreases as growth pressure increase
  - Peak observed at 1080 cm<sup>-1</sup> increased as growth pressure increased
  - Single phonon absorption related to nitrogen defect at 1095 cm<sup>-1</sup> and 1327 cm<sup>-1</sup> [8,9]



## **Ultra-Violet/Visible Spectroscopy (UV-Vis)**

- Absorbance spectra normalized to thickness of grown layer
- Used to quantify defect responsible for color observed after deposition Band at 360 nm related to vacancy clusters [10]

