ZnO Nanorod processed by Hydrothermal Method and its application in Surface Enhanced Raman Spectroscopy

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ABSTRACT

In this research, a hydrothermal method was used to grow zinc oxide nanorods, and the surface structure of nanorods was analyzed via Scanning Electron Microscopy (SEM).Hydrothermal process was modified to obtain variations of nanorods diameters and densities, and found out the optimal process of ZnO nanorods. In addition, Argentum layer was deposited on the surfaces of nanorods by Thermal Evaporation Coater and therefore this structure could be a substrate for Surface-Enhanced Raman Spectroscopy(SERS), then the light concentration DTNB (5,5'-dithiobis-(2-nitrobenzoic acid)) molecule was chosen to be a detective target. So, by inquiring the influence of nanorods diameter and density on peaks of DTNB that detected by SERS. In the future, this simple manufacturing technology will be applied to the analysis of drugs, cells and clinical fast screening samples.

Introduction

Surface Enhanced Raman Scattering (SERS) is an identification and analysis technique for rapid detection, non-destructive, high sensitivity and chemical specificity, and is a challenging area because it can exhibit great enhancement (~10^6). This study was applied to ZnO nanorods surface nanotechnology and Raman spectroscopy technology from the substrate preparation to improvement, in the future can be extended to different types of applications such as drug and, glucose, cells, microorganisms, tissues and clinical sample analysis, in order to bring greater well-being for human health.

Methods

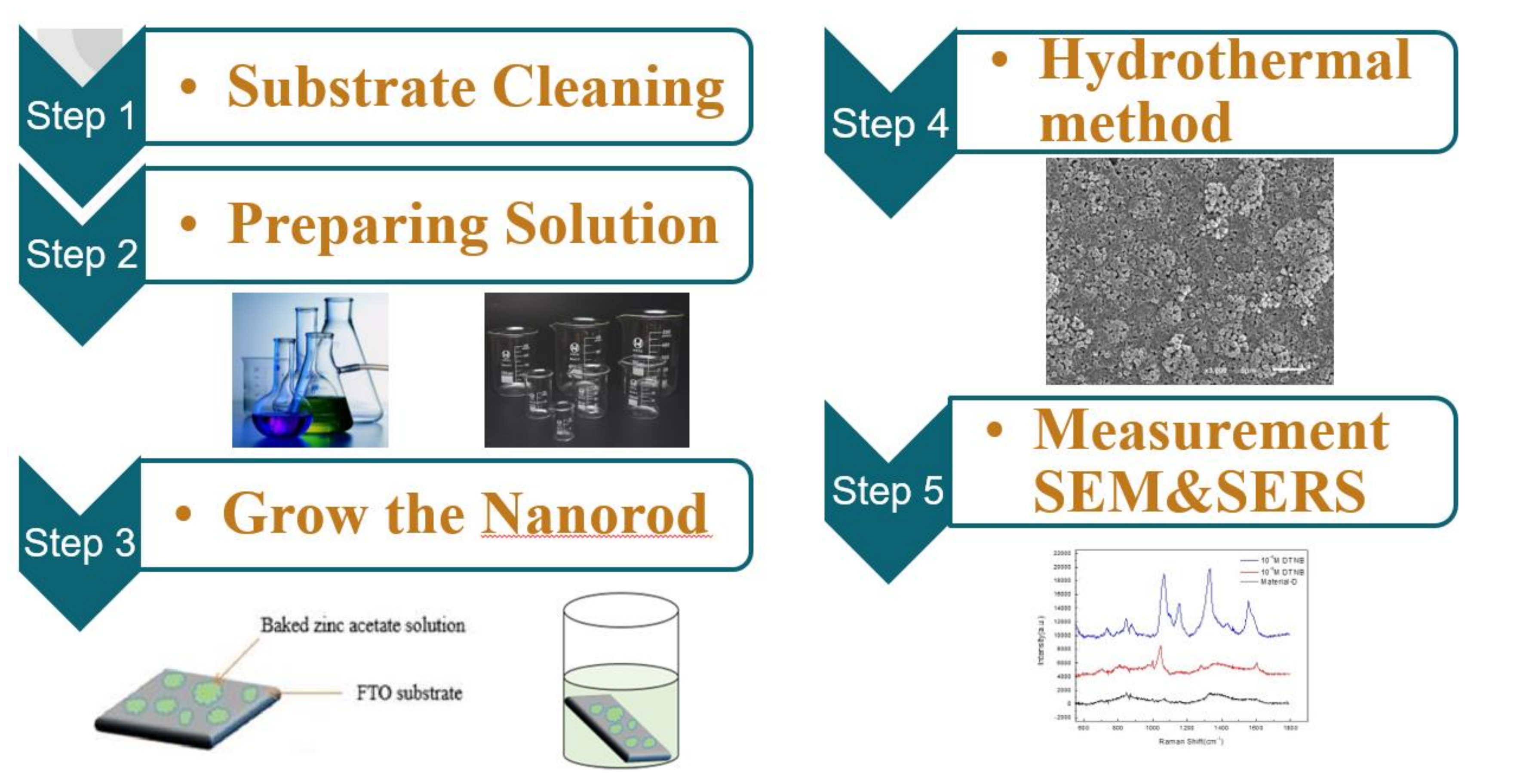

Fig.1 Experimental procedure

Results and discussion

Table.1 Experimental parameters

Time / Temp.	2hr	4hr	6hr	8hr
75 ℃		A	B	C
85 ℃	D	E	F	

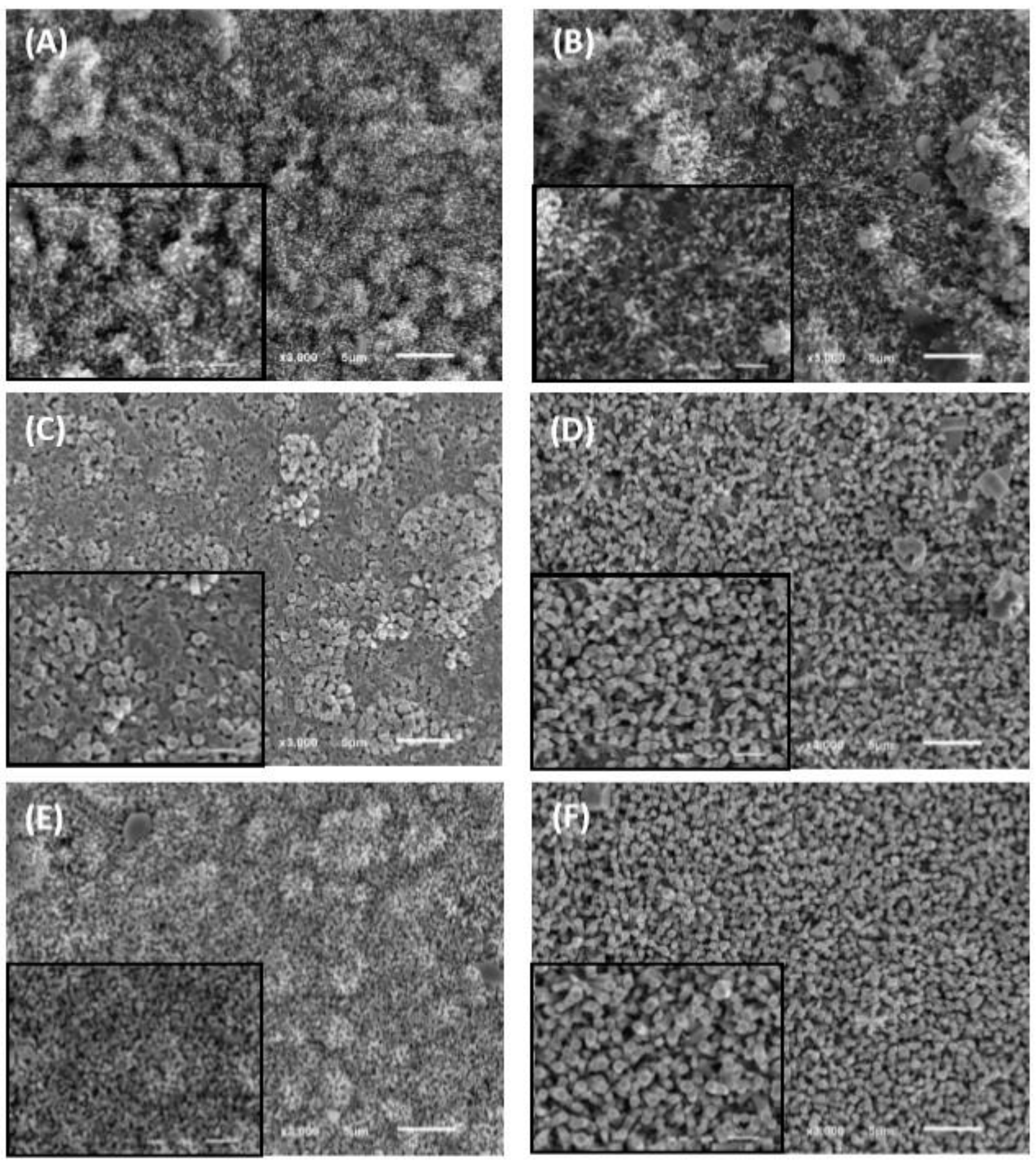

Fig.2 (A)~(F) Surface structure of nanorods by SEM

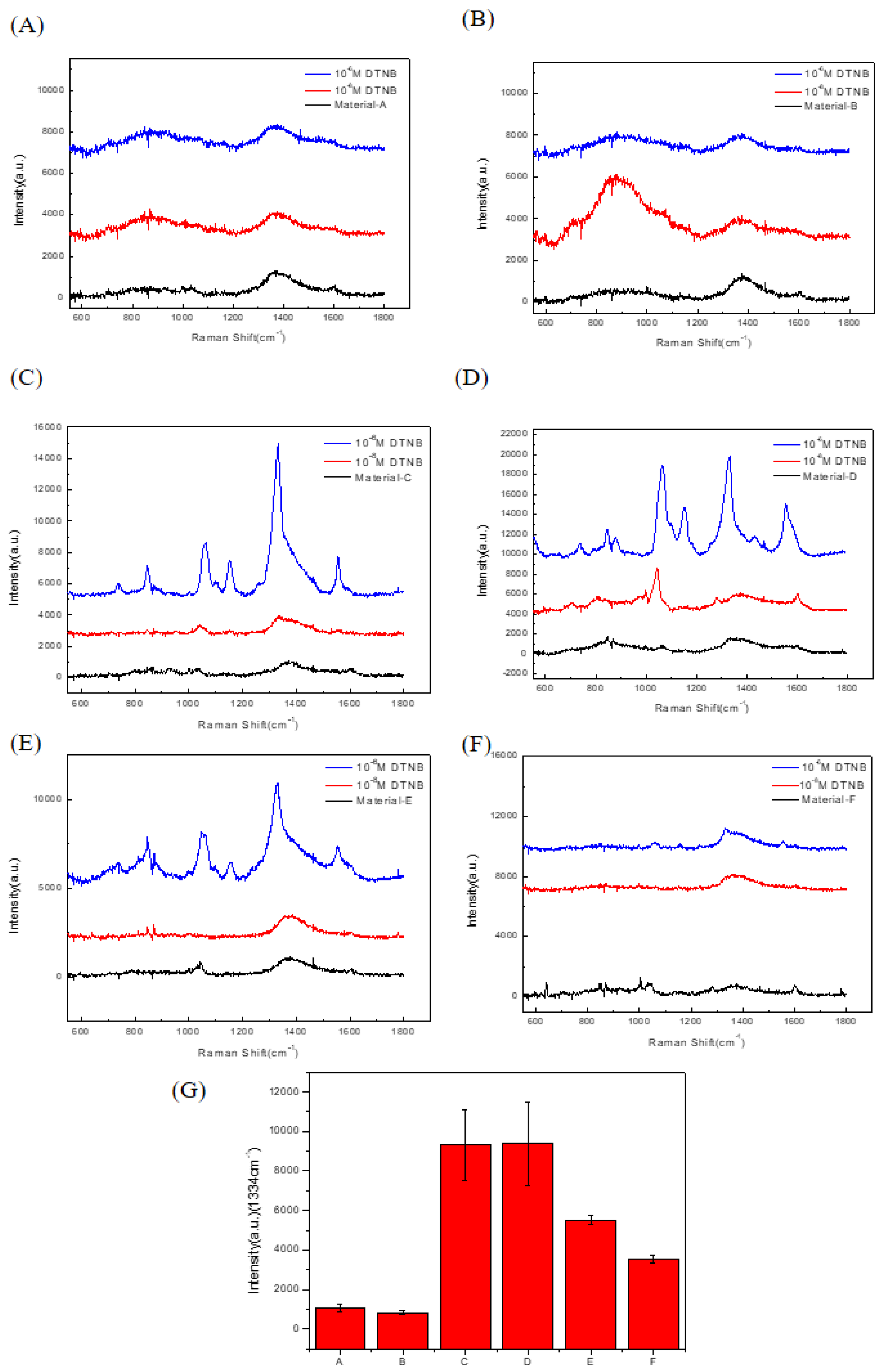

Fig.3 (A)~ (F) SERS for six different parameters of ZnO nanorods、(G) DTNB 10^{-6} M SERS strength at 1334cm^{-1} for six parameters

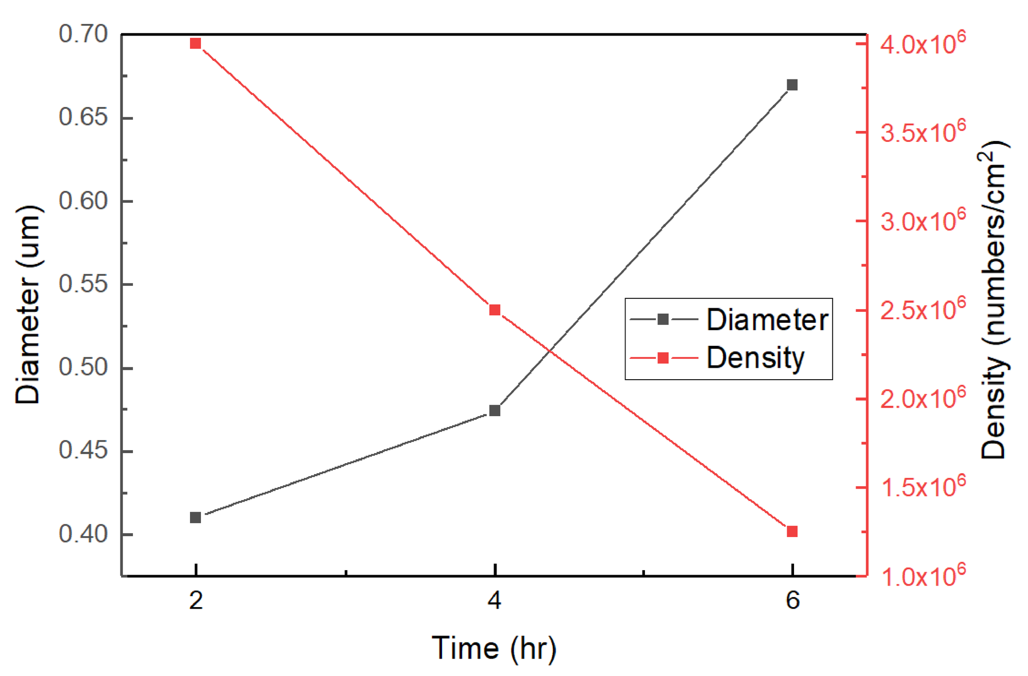

Fig.4 At 85 ˚C, the trend of diameters and densities with different times.

Conclusion

Growth of ZnO nanorod：In this research, we found that at the same temperature, the density decreased with increasing hydrothermal times, but the diameter also increased. So we concluded that the hydrothermal times and temperatures played an important part in nanorod's diameter and density.

SERS analysis：The porosity of nanorods also impacted on the intensity of DTNB. When the surface had more porosities, we could detect higher intensity of DTNB. This result showed that the porosity on surface would be better choice for DTNB detection.

Conclusion：We used low temperature and shorter time to obtain higher intensity of DTNB by hydrothermal method. In the future, this manufacturing technology will be easily apply to analyze cells, clinical fast screening samples and alcoholic.