# Atmospheric pressure plasma assisted preparation of ceramic submicron fibers

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Atmospheric pressure plasma generated in ambient air by Diffuse Coplanar Surface Barrier Discharge was used as an alternative to the conventional thermal sintering for the oxidation and removal of polymer matrix by the preparation of zinc oxide submicron fibers from polymer/precursor fibers. Morphology of fibers was observed by Scanning Electron Microscopy (SEM). Efficiency of removal of organics was studied by Energy-Dispersive X-Ray Spectroscopy (EDX). Changes in chemical bonds were investigated using Fourier Transform Infrared Spectroscopy (FTIR). Significant decrease of organics was detected and high porosity of fibers was observed after plasma exposure time in the order of minutes.

## 1. Introduction

Zinc oxide (ZnO) nanofibers, due to the unique electrical and optical properties, have attracted attention for applications in solar cells, gas and biosensors, transparent conductors, etc. [1]. Most common technique for preparation of ZnO fibers in submicron scale is thermal calcination of polymer/precursor fibers [2]. Due to the high temperature approach and long treatment times, conventional thermal calcination is economically and energetically demanding process.

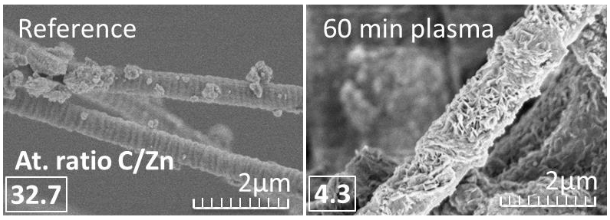
Plasma assisted calcination (PAC) is a novel low temperature process of oxidation and removal of base polymer by non-thermal plasma [3,4]. In this work, special type of dielectric barrier discharge, so called Diffuse Coplanar Surface Barrier Discharge (DCSBD) [5,6], was used for PAC of *polyvinyl alcohol/zinc acetate*(PVA/$Zn(O_2CCH_3)_2$) submicron fibers in ambient air.

## 2. Results and discussion

ATR-FTIR was used for characterization of specific chemical groups in the composite material before and after plasma treatment. Reduction of all major peaks related to PVA and zinc acetate indicate decomposition of the organic part of composite fibers.

The surface of fibers observed by SEM became after plasma calcination rough due to the removal of organics. Higher porosity of fibers can be advantageous in the application requiring high specific surface. However, DCSBD plasma does not cause breaking of fibers.

EDX measurements show decrease of carbon and increase of oxygen and zinc content. After 60 minutes of plasma treatment the atomic ratio of C/Zn decreased from 32.7 to 4.3 and O/Zn decreased from 18.0 to 6.1. Decrease of C/Zn atomic ratio indicates a very strong decline already in the first minutes.




## 3. Conclusion

The presented results show availability of DCSBD-based atmospheric pressure plasma assisted calcination for preparation of inorganic submicron fibers. The low temperature approach and short treatment time of process are very attractive as pre-treatment method or alternative to conventional thermal calcination.

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## 4. References

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