

# KINETICS OF DEWETTING OF SOLID SURFACES

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JANUARY 2014



# KINETICS OF DEWETTING OF SOLID SURFACES

by

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*Submitted*

*in fulfillment of the requirements of the degree of*

Doctor of Philosophy

to the



**INDIAN INSTITUTE OF TECHNOLOGY DELHI**

**JANUARY 2014**

# Certificate

This is to certify that the thesis titled “**KINETICS OF DEWETTING OF SOLID SURFACES**” being submitted by **Mr. Dhananjay Singh** in the Department of Chemical Engineering, Indian Institute of Technology, Delhi, for the award of the degree of Doctor of Philosophy, is a record of bona-fide research work carried out by him under my guidance and supervision. In my opinion, the thesis has reached the standards fulfilling the requirements of the regulations relating to the degree. The results contained in this thesis have not been submitted for the award of any other degree, diploma, associateship or similar title of any university or institution.

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# Acknowledgments

First of all, this appreciation is reserved for my supervisor, Prof. Rajesh Khanna. I am truly indebted to him for great motivation, encouragement and moral support at every moment of my research duration. I feel very fortunate that I got an opportunity to work under him. He has given me the way to grow as a researcher and scientist along with my academics profession. What I have learned during my study under his guidance is far more than this thesis itself, which I believe will be beneficial to me in a long way. Almost in all the tough situations that I faced in my academic life, professional life as well as my personal life, I got incredible support from him.

Now, I would like to express my gratitude to my research committee members, Prof. O.P. Sharma, Prof. Shantanu Roy and Dr. Vivek Buwa for their kind suggestions, guidance and motivation during the course of my research work.

I feel very grateful to my institute, I.I.T. Delhi for giving me a wonderful opportunity and facilities during this period. I am also thankful to the authorities of Institute of Engineering and Technology, Lucknow, where I am working as an Assistant professor in Chemical Engineering, to permit me for doing Ph.D. at IIT Delhi.

I would like to thank my friends Anil, Arvind, Vimal, Akhilesh, Sushil, Jogender, Adi Raju, Tirumala, Rahul, Dharendra, Praveen, Ramesh, Jag, Pradeep, Arindam, Ritunesh, Shailesh, Vijay, Durgesh, Kamlesh, Ranvir, Natthan and all other friends for their support and motivation. I would like to thank my colleagues of IET Lucknow, for their moral support.

Special thanks are due to Chaitanya for his massive support and help.

I would like to express gratitude to my teachers of *H.B.T.I. Kanpur, IIT Roorkee*

and *IIT Delhi*, for their motivation and affection to me.

I would like to thank my brother, sister and parents for their blessings, love and support. I would have never made it this far without them and can't thank them enough for always being there for me. Words cannot express my gratitude to my wife *Sunita* for her love and deep moral support during my research work. Last but not the least, a big thanks to my son *Arinjay* for loving me and also forgiving me for depriving him of love and attention he deserved, while I was busy in my research work.

New Delhi

**Dhananjay Singh**

# Abstract

*Dewetting* of solid substrates by overlying thin liquid films, is an important phenomena. Numerical simulations of 2 –  $D$  and 3 –  $D$  thin film equations were performed for a variety of force fields to study the kinetics of spontaneous and nucleated dewetting as well as that of true and pseudo dewetting. It is shown that it is not possible to reach the theoretically predicted asymptotic constant rate of dewetting. Based on simulations of simultaneous dewetting by multiple holes it is shown that the fractional dewetted area shows a sigmoidal growth in time. The rate increases in the beginning as more and more dry spots (holes) open up and contribute to dewetting. The rate decreases towards the end as holes start slowing each other. The rate remains mostly uniform in the middle region when all the holes are moving independently. The number of holes required to arrive at a statistically characteristic dewetting behavior is found to be more than 10000 for a 1nm thick film. No difference was found in the kinetics of pseudo and true dewettings as long as films show dewetting through holes as opposed to morphological phase separation into droplets and equilibrium film. It is found that nucleated holes follow three stages of hole growth viz. (1) fast rearrangement to get rid of signature of nucleation initial condition, (2) faster growth than spontaneous dewetting and (3) slowing down to match the growth of spontaneous dewetting. Also, the kinetics was found to be independent of gravitational attraction for film thicknesses as high as 500 nm.

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