

# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
	References	3
<b>2</b>	<b>High Temperature Cuprate Superconductors</b>	<b>5</b>
2.1	General Properties of Cuprates	5
2.1.1	Crystal Structure	5
2.1.2	Phase Diagram	6
2.1.3	Electronic Structure of Cuprates	7
2.2	Pseudogap and Precursor Superconducting State	9
2.2.1	Pseudogap State	9
2.2.2	Precursor Superconducting State	13
2.3	General Optical Properties of Cuprates	19
2.3.1	In-Plane and <i>c</i> -Axis Optical Properties	19
2.3.2	Pseudogap and Superconducting Gap Behavior in <i>c</i> -Axis Optical Spectrum	22
2.3.3	Superfluid Density in <i>c</i> -Axis Optical Spectra	23
2.3.4	Transverse Josephson Plasma (TJP) Resonance Mode	25
2.3.5	Impurity Effect on <i>c</i> -Axis Optical Properties	27
2.4	Aim of This Study	29
	References	29
<b>3</b>	<b>Experimental Procedure</b>	<b>33</b>
3.1	Samples	33
3.2	Principle of the Fourier Transform Infrared (FTIR) Spectroscopy	37
3.3	Experimental Details	39
3.3.1	Fourier Transform Infrared (FTIR) System	39
3.3.2	Low Temperature Measurements	40
3.3.3	Reflectivity Measurements	42

3.4	Optical Relations . . . . .	43
3.5	Fitting of the Reflectivity Spectra . . . . .	46
	References . . . . .	49
<b>4</b>	<b>Results and Discussion . . . . .</b>	<b>51</b>
4.1	<i>E</i> // <i>c</i> -axis Optical Measurements . . . . .	51
4.1.1	Doping Dependent Optical Spectra of YBa <sub>2</sub> Cu <sub>3</sub> O <sub>y</sub> . . . . .	51
4.1.2	Zn-Substitution Effects on Optical Response . . . . .	54
4.2	Discussion on Pseudogap. . . . .	57
4.2.1	Pseudogap in the Underdoped Region . . . . .	57
4.2.2	Pseudogap in the Overdoped Region . . . . .	62
4.2.3	Interpretation of the Pseudogap . . . . .	64
4.3	Discussion on Precursor Superconductivity . . . . .	66
4.3.1	Precursor Superconducting State in the Optical Conductivity . . . . .	66
4.3.2	Comparison of Our Phase Diagram with the Results of Other Probes . . . . .	75
4.3.3	Interpretation of the Precursor Superconducting State . . .	76
4.4	Remarks on Kinetic Energy Driven Superconductivity. . . . .	79
	References . . . . .	82
<b>5</b>	<b>Conclusion . . . . .</b>	<b>87</b>
5.1	Pseudogap in the Superconducting State . . . . .	87
5.2	Pseudogap in the Overdoped Region . . . . .	88
5.3	Precursor Superconducting State . . . . .	88
5.4	Kinetic Energy Driven Superconductivity. . . . .	89
5.5	Future Work . . . . .	89
	<b>Curriculum Vitae . . . . .</b>	<b>91</b>

Pseudogap and Precursor Superconductivity Study of  
Zn doped YBCO

Uykur, E.

2015, XIII, 93 p. 79 illus., 54 illus. in color., Hardcover

ISBN: 978-4-431-55509-4