

# Chemical and Physical Behavior of Human Hair

5th Edition



Clarence R. Robbins

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With 233 Figures

 Springer

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ISBN 978-3-642-25610-3 e-ISBN 978-3-642-25611-0  
DOI 10.1007/978-3-642-25611-0  
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2012930823

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*To my wife, Gene for 50 years of hope, making every day meaningful for me. To my father, an example for me and an inspiration to many. To my mother, who struggled with health problems throughout her long life but accepted it with grace. To my daughter Laurie and her husband T.J. and little Griffin; to my son, Mark; to my brother John and his family and to my “little sister” Becky and to Ken and his family and to my many other relatives and friends who help to make life meaningful for me.*

*I would like to dedicate this fifth edition to five colleagues and friends who have had a very positive influence on my life and/or my career in science. To John Wright, who initiated my interest in chemistry; to Bill Truce, who taught me to work as an independent scientist; to George Scott, my mentor in keratin fiber science; to Charles Reich, a colleague who kept me on my toes scientifically, but who unfortunately passed away about a year ago and to Glenn King a wonderful friend who passed away just a few days ago.*



# Preface to the Fifth Edition

Nearly 9 years have passed since the writing of the fourth edition and much progress has been made in that time span. Identification and classification of the chromosomes and genes involved in the important IF (intermediate filament) and KAP (keratin associated proteins) proteins of human hair and some of the genes involved in different forms of alopecia and hair abnormalities has occurred. Many of the SNPs of different genes in natural hair color and hair fiber size and shape and the geographic influence on these genes and properties have also been made. Our understanding of the distribution of different proteins in the fiber and its control of hair fiber curvature has increased dramatically. Methods development has also increased at a rapid pace. For example, a new hair curvature (most important single fiber property of hair) method has been described and applied to the scalp hair of more than 2,400 different persons in more than 20 different countries. Our understanding of hair growth, hair breakage, the torsional behavior of hair and the mechanisms of important oxidative reactions (chemical bleaching and sunlight degradation) in human hair has also improved greatly.

This edition contains expanded data and more comprehensive data bases with statistical analyses for hair fiber diameters, hair densities (hairs/cm<sup>2</sup>), ellipticity, incidence of hair graying, male pattern alopecia, female pattern alopecia versus age, and comparisons of most of these properties among different geo-ethnic groups and males versus females. Sections on the effects of pregnancy and the menopause on hair fiber and assembly properties have also been expanded as well as a new Chapter providing definition for most of the important cosmetic hair assembly properties and how these properties are influenced by changes in single fiber properties in general and as a function of age.

Clermont, USA

Clarence R. Robbins





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# Abbreviations

C	Curvature
D	Diameter
S	Stiffness
E	Static charge
E <sub>S</sub>	Stretching modulus or Young's modulus
E <sub>B</sub>	Bending modulus
E <sub>T</sub>	Torsional modulus
R	Rigidity
G	Stiffness coefficient
SAXS	Small angle x-ray scattering
ESCA or XPS	X-ray photoelectron spectroscopy
Wnt proteins	A family of signaling molecules that regulate biological processes
Lef1	Lymphocyte enhancement factor
BMP	Bone morphogenetic proteins
Shh	Sonic hedgehog
SNP	Single nucleotide polymorphism
IF	Intermediate filament
KAP	Keratin associated protein
CMC	Cell membrane complex
UV	Ultraviolet light
MPA	Male pattern alopecia
FPA	Female pattern alopecia
18-MEA	18-methyleicosanoic acid
SLS	Sodium lauryl sulfate
SDS	Sodium dodecyl sulfate
DHT	Dihydrotestosterone

