INTRODUCTION

Wood, which looks quite solid as studied by the naked eye, actually has a rather complicated, but very exquisite structure developed by Nature to fulfil the needs of a growing tree. How well the structure fulfils the needs of a construction material used by humans is another thing. Besides being an important construction material, today wood is also an important source of precursors for medical and chemical compounds used by human beings. These and many other aspects of wood are the topics that materials science tries to clear up. When wood is used as a constructional material, the human interest concentrates normally on xylem, the “wooden” inner portion of the stem of a tree. The outer section of the tree, the bark and cambium, interests humans mainly for other than constructional reasons.

From the point of view of materials science, wood is a very clever polymer matrix composite, in which fiber reinforcing is applied in a cell-type structure consisting of different kinds of cells, the walls of which are laminates of differently fiber reinforced laminates or of groups of laminates. As the reinforcing fibers are also polymers, the total structure of wood, with negligible exceptions, is polymeric and thus organic. The reinforcing fibers are capable of strain hardening, i.e., their strength increases when loaded over their instantaneous yield strength. Brittleness is decreased by the orientation of the most important groups of reinforcing fibers, by a smooth change from one structure to the neighboring one and by high quality clue between the cells. Furthermore, the reinforcing fibers consist of a large number of nanoscale microfibers and in that way increase the length of reinforcing fibers by several magnitudes from that of individual microfiber. Because of these clever structural solutions, wood is a good example for developing the synthetic polymer matrix composites to reach better strength properties. In the case of wood, one has to remember that the structure is meant to serve a growing tree, i.e., in wet conditions under different kinds of weather conditions. When human beings use wood as construction material, it is used in a more or less dry condition and the requirements are different from those in a living tree.

As wood is an organic polymer matrix composite, the study of wood could be assumed to be one of the main areas of polymer scientists. This is not true, however, the materials scientists working on polymers are almost absent in the research of wood. The situation is actually bitty, as wood could give plenty of ideas applicable also in the synthetic polymers and their composites. This situation reflects itself also in the content of this publication

The present papers describe some advances reached in the study of the micro- and the nanostructure of the xylem portion of the wood stem, their relationship with deformation and mechanical properties, plus mechanical and chemical properties in a more macroscopic scale. Thus, the interest in the present publication will remain within the frame of xylem. Those interested in the structure of the entire tree are advised to another recent publication [1].

As the papers will concentrate on very specified and limited areas, background knowledge on the topics concerned in the papers will be given first in order to help those readers who are not so familiar with the present specific topics or research areas.

Advances are reached in many other topics of wood, e.g., in the mechanisms of fatigue and creep, in the influence of strain rate on the mechanical properties, in the combination of nano and micro scale studies with the macroscopic testing, etc. Unfortunately, these papers did not become ready for this publication.