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prof. RNDr. Zdeněk Doležal, Dr.
Vice Dean of the Faculty of Mathematics and Physics
Charles University
Ke Karlovu 2027/3
16 Praha 2
Czech Republic

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Dear prof. Doležal,

At this time, I am writing to you with my review of the Habilitation Thesis submitted by Dr. Josef Stráský. I do apologize for my delayed response but unfortunately, I have had a run of bad luck with my health, and this has resulted in the delay. I am by training and practice a physical metallurgist with an interest in a number of different alloy systems, of which titanium alloys have been a subject of concentrated effort. Hence, I am very familiar both with the subjects of research undertaken by Dr. Stráský, and also with much of his published work. Permit me to make some overview comments based on this familiarity of Dr. Stráský's research output. Thus, I consider him to be one of the international experts in his topics of study. His scholarly publications and conference presentations are of the highest standard, and describe both detailed scientific discovery and technological impact, as I will illustrate in the narrative below.

He has undertaken research into two specific topics involving titanium alloys, the first being the development of new biomedical alloys, and the second being an investigation of ultra-fine grained titanium alloys for biomedical applications. For his future work, he aims to focus on two other topics, the first being powder metallurgy processing and additive manufacturing of titanium alloys, and the second being the exploitation of phase transformations in metastable β titanium alloys in an attempt to induce significant strain hardening in these alloys, a property absent in most conventional titanium alloys. His choices of subjects of study, i.e., both current endeavors and his future themes, demonstrate that Dr. Stráský has selected topics that are considered by the titanium community to be among the most exciting and most likely to result in significant scientific

discoveries and technological advances. Indeed, his published record is a collection of scholarly papers that describe a number of these exciting advances that he has achieved.

Regarding the first of his two current scientific foci, namely development of new biomedical alloys, his achievements are illustrated in the papers A0-A5 in his Habilitation Thesis. The scientific significance of this topic involves the challenge of developing new titanium alloys that possess elastic moduli which match that of human bone. The need to lower the value of the modulus is to minimize the extent of load shedding between the metallic component and the surrounding bone which reduces the integrity of the implant, and promotes its possible failure. Dr. Stráský has explored the possibility of making use of alloying of β titanium alloys in an attempt to effect a change of the electronic structure and hence the elastic modulus. He has made use of primarily the elements oxygen, iron, and silicon, and has shown that values of the moduli in the range of 63.5-72.5 GPa can be achieved, which is a remarkable reduction in modulus compared with typical values of ≈ 110 GPa in α/β Ti alloys. The application of techniques of materials characterization, a key need, in these studies have been done at the highest of standards, i.e., at the level of an international expert. The scientific deductions have also been as expected of a top academician, and I judge this aspect of his work to be outstanding.

Regarding his second current scientific focus, he has made a study of how materials processing may be used to increase the strength of alloys that have compositions which exhibit low values of the elastic modulus (as per the first topic). The significance of this work is that actual implants must exhibit a *balance* of properties that include low modulus, high strength and sufficiently appropriate values of fatigue life. Dr. Stráský has made use of two techniques that result in severe plastic deformation (SPD) to produce ultra-fine grained alloys (UFG), one being high pressure torsion (HPT) and the other equal-channel angular pressing (ECAP). These severely deformed materials are extremely difficult to characterize, and Dr. Stráský has been very creative in his approach to materials characterization. Thus, he has applied a combination of positron annihilation spectroscopy, resonant ultrasound spectroscopy, electrical resistivity, X-ray diffraction, scanning electron microscopy, and transmission electron microscopy. It is very rare for a given investigator to apply so many and varied techniques in order to achieve a thorough description of the state of a material. In consequence, this is the first time that it has been possible to correlate complex strain development to the evolution of microstructure in an HPT processed β titanium alloy with a focus on deformation processes. This study, involving novel processing to effect strength and fatigue life in titanium alloys possessing low elastic moduli, serves to confirm the scientific excellence of Dr. Stráský's professional activities. Thus, the topic is highly relevant, and the scientific activities have been undertaken at the highest of levels.

I have stated that Dr. Stráský's research efforts involve the application of a number of experimental techniques, which are applied at an international level of competence. It is interesting to note that for one of these techniques, electrical resistivity, he is perhaps the *world's leading expert*. Thus, the quality of materials characterization that is performed by Dr. Stráský and his group is superb and this is a technique that is often ignored by many investigators, including myself, to the detriment of our work.

My check on plagiarism raises no problems or issues.

In summary, it is very evident that Dr. Stráský is a scientifically mature researcher and a respected academician. He is very creative in his choices of study, and in their execution. He then undertakes those investigations in a manner involving scientific and technical excellence, at a world-class standard. In my humble opinion, he more than exceeds the standards required to join the professorial ranks, and to then continue to provide us all with scholarly reports through publications and conference presentations during the further execution of his outstanding career. This letter clearly demonstrates that I have the highest opinion of Dr. Stráský, and so I am able to recommend him enthusiastically to you in the strongest of terms for promotion to the professorial ranks.

Yours sincerely,

