Tubular mechanics in oil-gas wells and its applications
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A large number of string materials, such as the drill string, pumping rod, tubing, coiled tubing, casing, etc., are used and often fail in oil and gas drilling and production. How to use them best? This presentation introduces the well trajectory, the motion, the load and the failure of these strings in oil and gas wells first; then establishes the three principles of the tubular string mechanics: Equilibrium, minimum potential energy and minimum power dissipation rate; after that establishes the fundamental equations for dynamic analysis of these strings in oil and gas wells. The fundamental equations have successfully unified all the differential equations used in dynamic analysis of these strings in oil and gas wells. Thus, these equations have broad uses in drilling and production. After that, this presentation introduces static buckling of these strings in oil and gas wells, tension-torque model of these strings and its applications, mechanical analysis of tubing string in well testing operation and fracturing operation, vibrations of drill string, dynamic analysis of sucker-rod pumping systems in directional wells, mechanical analysis of bottom hole assembly and well trajectory control, mechanical analysis of tubing and casing in thermal recovery wells, cementing techniques with pre-expansion of casing to prevent casing from failure in thermal recovery wells and mechanical analysis of expandable slotted-liners. This presentation’s results can also be used in (1) vascular interventional medicine; (2) micro/nano systems.

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Effect of different micro-structural parameters on hydrogen induced cracking in an API X70 pipeline steel
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In this study, the surface and cross section of an as-received API X70 pipeline steel was studied by SEM and EDS in order to categorize the shape and morphology of inclusions. Then electrochemical hydrogen charging using a mixed solution of 0.2 M sulfuric acid and 3 g/l ammonium thiocyanate has been utilized to create hydrogen cracks in X70 pipeline steel. After hydrogen charging, the cross section of this steel has been accurately checked by SEM in order to find out hydrogen cracks. The region of hydrogen cracks was investigated by SEM and EBSD technique in order to predict the role of different micro-structural parameters involving hydrogen induced cracking (HIC) phenomenon. The results showed that there were anisotropy in microstructure and distribution of inclusions in the cross section of the tested steel. Moreover, several types of inclusions in as-received X70 steel were found. However, only manganese sulfide and carbonitride precipitates were found to be harmful in HIC phenomenon. Finally, a different type of HIC crack was found and studied by EBSD technique and role of micro-texture parameters on HIC was discussed.

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