中国有色金属学报
中国有色金属学报(英文版)
中国科学技术协会 主管
中国有色金属学会 主办

论文摘要

中国有色金属学报
ZHONGGUO YOUSEJINSHUXUEBAO XUEBAO
第17卷 第2期 (总第95期) 2007年2月

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文章编号：1004-0609(2007)02-0270-07

Al2O3/ZrO2(Y2O3)复合材料的可靠性、磨损形态及其切削耐用度

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摘 要：研究了Al_2O_3和$Al_2O_3/ZrO_2(Y_2O_3)$复合刀具材料的Weibull分布、磨损形态及其切削耐用度。用一元线性回归方法确定$Al_2O_3/ZrO_2(Y_2O_3)$刀具的耐用度参数，分析切削条件对$Al_2O_3/ZrO_2(Y_2O_3)$复合刀具材料寿命的影响。结果表明：Al_2O_3和含2%(摩尔分数)及3%Y_2O_3的$ZrO_2/Al_2O_3(Al_2O_3/ZrO_2(2Y)$及$Al_2O_3/ZrO_2(3Y))$复合刀具材料Weibull模数的$m$值分别是5.6、10.2和11.7，说明$Al_2O_3/ZrO_2(3Y)$陶瓷的可靠性最优；$Al_2O_3/ZrO_2(3Y)$复合刀具切削40CrMoNiA合金钢的磨损形态主要来自磨粒磨损和粘结磨损，耐用度参数v_c、f、a_p的指数值分别为1.3、1.69和0.66，陶瓷刀具更适合高速切削，最大影响因素是进给量(f)，在最佳切削条件下(v_c=140 m/min，a_p=0.5 mm和f=0.3 mm/r)切削耐用度为3 h。

关键字： Al2O3/ZrO2(Y2O3)复合材料；刀具；可靠性；磨损形态；一元线性回归；耐用度

Reliability, abrasion modality and cutting lifetime of Al2O3/ZrO2(Y2O3) composites

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Abstract: The Weibull distribution, abrasion performance and cutting lifetime of Al2O3 of Al2O3/ZrO2(Y2O3) composites were investigated. The cutting lifetime of Al2O3/ZrO2(Y2O3) cutting tool was established using single linearity regression. The effects of different cutting conditions on the cutting lifetime of Al2O3/ZrO2(Y2O3) composite cutting tool were

completely analyzed. The results show that Weibull modula (m) of Al2O3, Al2O3/ZrO2(2Y) and Al2O3/ ZrO2(3Y) composites are 5.6, 10.2 and 11.7 respectively, showing that the Al2O3/ZrO2(3Y) composite has the best reliability. The abrasion mechanism during cutting process of 40CrMoNiA alloy steel by Al2O3/ZrO2(Y2O3) cutting tool results from grain abrasion and adhesion abrasion. The parameters in the endurance model, vc, f and a p are 1.3, 1.69 and 0.66, respectively. The cutting tool material investigated at present is suitable for high-speed cutting. The maximal influence factor is the amount of feed (f). Under the optimum cutting conditions, vc＝140 m/min, ap=0.5 mm and f=0.3 mm/r, the endurance life of the composite cutting tool is 3 h.

Key words: Al2O3/ZrO2(Y2O3) composite; cutting tool; reliability; abrasion modality; single linearity regression; cutting lifetime